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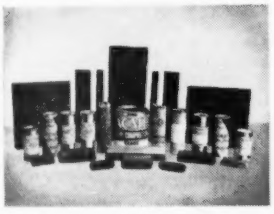

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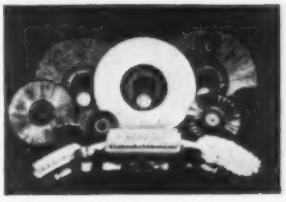

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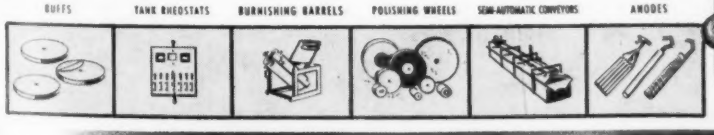

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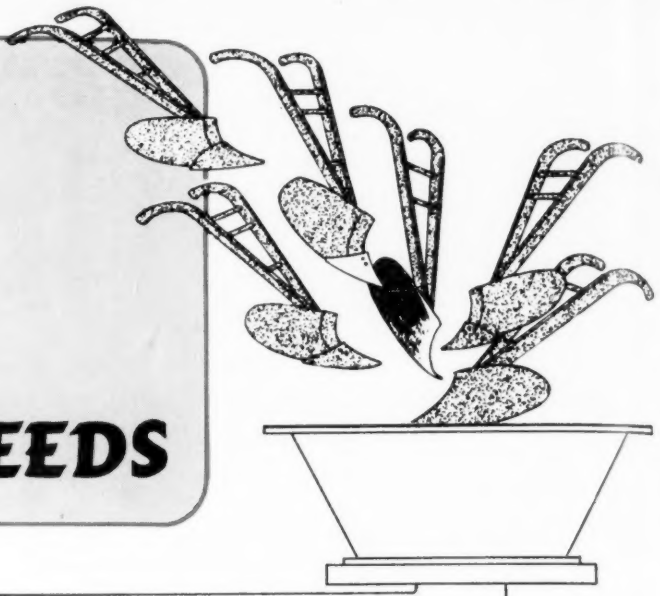

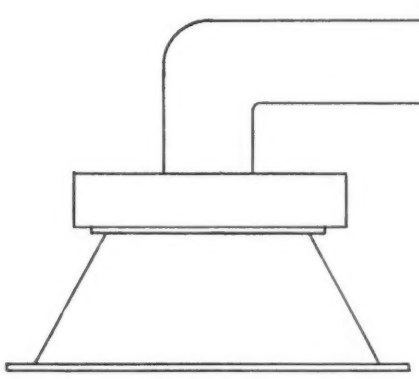

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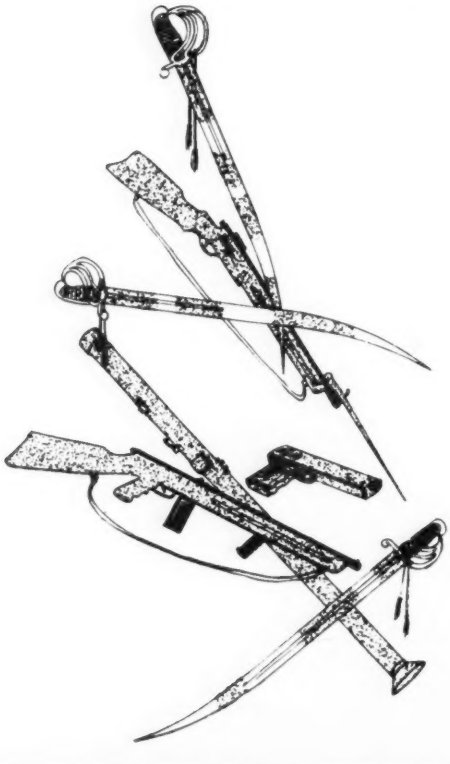

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COMING SOON

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The use and function of sulfites and bisulfites in cyanide plating baths.

Chromium plating from non-aqueous organic media.

Automatic electropolishing machine for electropolishing small intricately shaped brass costume jewelry and similar items.

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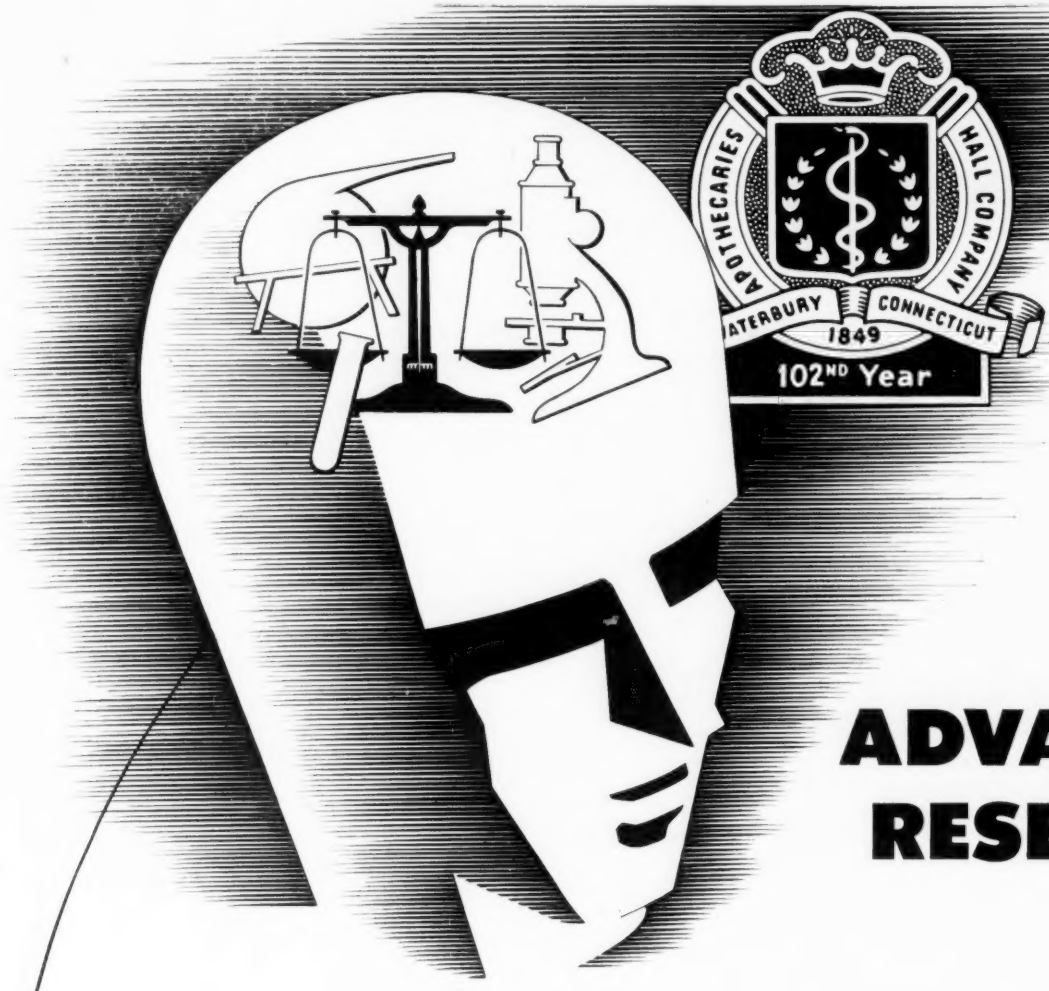

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The WASHINGTON OBSERVER

News and Views from The Nation's Capitol

George W. Grupp

• Amendment No. 1 of N.P.A.'s Nickel Order M-14 has banned the usage of nickel on over 400 different consumer items. It is no longer permissible to nickel plate about 150 of these items. (See this issue for details.) The basic Nickel Order M-14 was also amended to prohibit the manufacturers of nickel alloys to extend priority ratings to replace nickel used prior to January first.

• The N.P.A. has tightened its control of tin by reducing the former level for civilian consumption by about one third. Schedules IV, VI, and VII of amended Tin Order M-8 elaborately describe the new limited uses of tin for plating, and specify new coating weights for tinplate for cans and closures. (See elsewhere in this issue for details.)

• If strict limitations are imposed on non-essential uses of zinc many users will go out of business, since the small users cannot normally get "DO rated" orders except on sub-contracts.

• The drafting of electroplaters is beginning to disturb the industry. It feels that it is making an essential contribution in the production of defense products, and that it takes a long time to train new personnel to become skillful.

• Order M-12 was amended by N.P.A. to permit producers and users of copper and copper base alloys to readjust their base period average if their plants were inactive for more than fifteen consecutive days during the first half of 1950. The N.P.A. also amended Copper Order M-16 to permit foundries and chemical plants to melt and process copper scrap generated in their own plants.

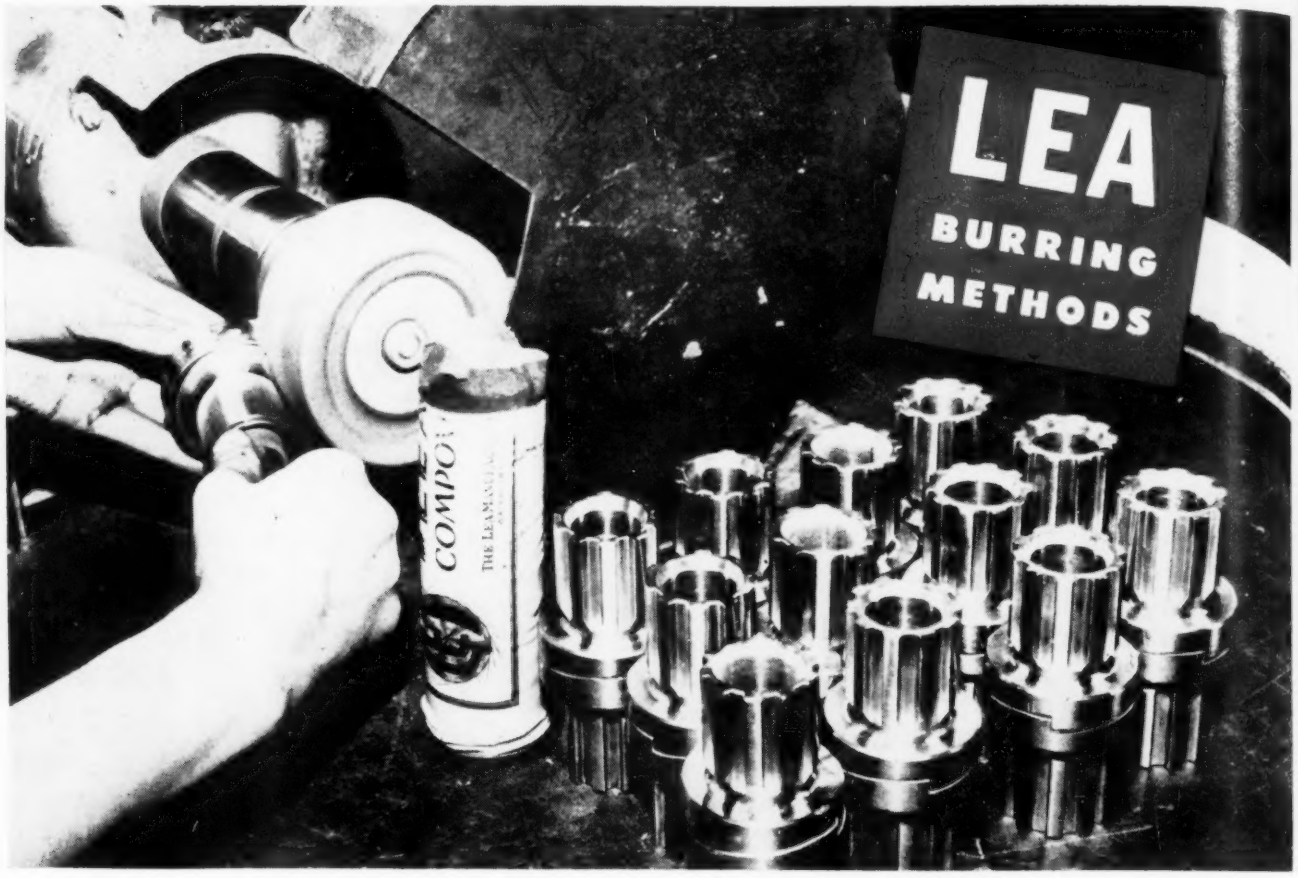
• The electrical conduit industry believe that a substantial amount of zinc can be saved for essential uses if there is a reduction in the amount of zinc on galvanized conduit by reducing the number of dips in the requirements of the Preece Thickness Test from four to two; also when the conduit is used for outdoor purposes the coating should be pass only two dips, plus having two protective coats of weatherproof paint.

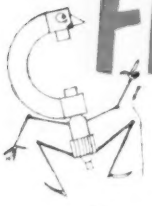
• A sound controlled materials plan is being sought by some businessmen because their clerical staffs are being swamped with paper work due to the increasing number of directives, regulations, revisions and amendments. The N.P.A. expects to place in effect about July 1st a Controlled Materials Plan for aluminum, copper and steel.

• Job control regulations are being formulated. They will be mild at first. Workers will not be able to change jobs at will; employers will not be able to hire and discharge with perfect freedom.

• The House has passed a measure authorizing the Government to recapture "excessive" defense contract profits.

• To aid businessmen in the day-to-day developments of the N.P.A., the Department of Commerce has increased its field offices from 42 to 73.





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Decorative Plating's Draft Status

The most recent regulations restricting nickel and tin plating, together with the previous rulings on copper, brass and cadmium plating have just about settled the status of decorative electroplated finishes "for the duration." While there are no comparable end-use restrictions on the other two popular finishes, zinc and chromium, the tight supply situation in zinc will automatically cut down on the amount of plating of this metal. Without undercoatings of copper or nickel, thin deposits of chromium are useless. Heavy chrome will be used more widely than ever, but this is not much consolation for the decorative finishing field.

Outside of the automotive plating field, it will be a plain case of plating priority-carrying military items or not plating at all, at least until a sufficient stock-pile of weapons is made available for immediate use when required. Some easing up on plating restrictions can then be expected. Most expert opinions place this time as late 1952.

Zinc plating looks like the only hope for decorative plating (if you can get any zinc). Fortunately, it provides excellent protection for steel, and with some of the newer post-plating treatments it can be made quite attractive as well. Chrome over zinc plate is a possibility for some decorative items.

The largest user of plated finishes, the automotive industry, while suffering somewhat from present regulations, does not fare as badly as was at first expected. Essential bright work, such as bumpers, bumper guards, hub caps, window frames, door handles, and several other lesser items can still be nickel and chrome plated, with bumpers and guards allowed up to .001" of nickel. Principally because of restrictions on the use of stainless steel, not plating, passenger cars for the next several years will have less of the garish trim of recent models, but they will by no means become dull-looking. Inasmuch as passenger car production is expected to be cut to about 60% of last year's figure, and nickel consumption for plating the above-mentioned essential bright work is permitted up to 65% of the 1950 average, there should be no particular problem for the automotive plating industry to make the available nickel supplies go around.

This branch of the plating industry thus continues to be charged with the responsibility of carrying the banner for high quality, durable plated finishes.

W. A. Raymond

Editor

The Effect of Operating Conditions on the Hardness of Chromium Plate

By R. E. Howell,* *Univ. of Wichita, Wichita, Kans.*

THE unique combination of properties shown by electrodeposited chromium makes chromium plate very useful in many industrial applications. Among these properties are hardness, brightness, tarnish resistance, and low coefficient of friction. Chromium deposits are harder than any other electrodeposits, and are much harder than chromium metal obtained by conventional metallurgical reduction. However, the degree of hardness is often affected by the temperature, current density, and concentration of the solution during the plating process. This study was undertaken to determine the effects of various sets of conditions on the hardness of electrodeposited chromium and to determine if deposits harder than those reported in the literature could be obtained. Incidental to the work was the problem of selecting the most desirable load to use in testing the hardness of chromium deposits in the Tukon Tester.

Several theories have been proposed for the hardness of chromium deposits.[1,2,4,8] The crystalline structure, grain size, internal stresses, and inclusions of oxygen and hydrogen, either free or combined, are the factors usually considered to be the cause of the great hardness. However, this work, being primarily a quantitative study of hardness plating conditions relationships, does not attempt either to support any of these theories or to offer a different one.

In his review of chromium plating, *Dubpernell*[3] mentions that many contradictory reports are given in the literature on the hardness of chromium deposits. This is due partly to the difficulty in making hardness tests on the thin specimens. The effects of a softer base-metal are quite pronounced, especially if heavy loads are used or if the depth of penetration is appreciable compared to the thickness of the deposit. Many of the earlier workers reported the hardness values in Brinell numbers; however, there was a need for a tester designed specifically to accommodate thin layers of metal. The Knoop Indenter was developed at the National Bureau of Standards to meet this need. The resulting Knoop numbers vary somewhat from Brinell numbers. *Knoop* and *Peters*[5,7] give a table comparing these two sets of numbers and Vickers numbers. Examples from their table are, for respectively hard steel, steel, and rolled copper, 780, 456, and 104 Brinell; 791, 496, and 125 Knoop; and 894 493, and 111 Vickers.

The results of some previous studies on the hardness of chromium plate, as given in Dubpernell's paper, are as follows (all hardness numbers are Brinell unless otherwise mentioned):

Adcock, 600-650 BHN

MacNaughton and Hothersall, 400-950 BHN

Kinzell, above 1000 BHN

Jenicek, 800-1000 BHN

Websersinn and Hosdowich, from 580 BHN for matte deposits to 1250 BHN for certain "burned" deposits; bright deposits, 1000-1025 BHN.

Cymboliste, 400-1200 BHN

Bilfinger, 850-1200 (Vickers diamond pyramid)

Knoop and Peters, 850-953 (Knoop).

Although the conditions of plating are not expressed, it is fairly obvious that the deposits tested by these workers must have been obtained under widely varying conditions.

Experimental Conditions

Because the changes in plating conditions have such a great effect on the deposit produced, it is necessary to maintain strict control over all phases of the plating processes. The equipment, materials, and procedures were chosen to yield the greatest possible uniformity, so that any differences in deposits would be due entirely to the conditions being studied. These conditions were current density, solution temperature, and concentration of hexavalent chromium.

The plating bath was contained in an insulated rectangular glass tank whose operating capacity was about 3.6 liters. A constant-level device supplied distilled water to replace that lost by evaporation. Temperature was controlled by a mercury thermostat. Heat was supplied by an electric bulb inverted in the solution. Coils were provided for circulating either hot or cold water to aid in attaining or maintaining temperature. The bath was stirred constantly.

The plating solutions were composed of commercial CrO_3, reagent H_2SO_4, and distilled water. Concentrations were 400 g./l., 250 g./l, and 150 g./l. of chromium trioxide, the ratio CrO_3:SO_4 being in each case 100:1. Frequent analyses and the indicated replenishments were made. Analysis for CrO_3 was by addition

**Thesis submitted in partial fulfillment for the requirements for a Master's Degree.*

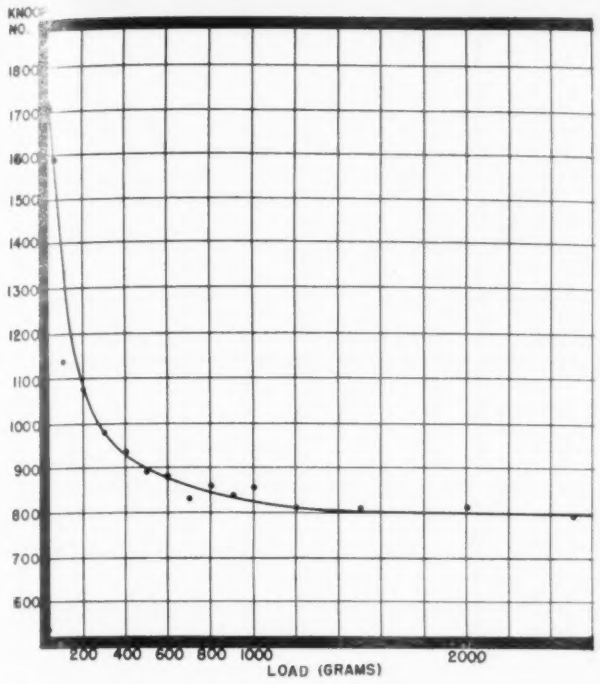

Figure 1. Variation of hardness measurement with increasing loads. All tests on a single .006" thick chrome plated sample.

of ferrous ion and back-titration with dichromate. Analysis for sulfate was gravimetric, by precipitating barium sulfate after reduction of the chromate with isopropyl alcohol in HCl and glacial acetic acid.

The specimens to be plated were one inch wide and about five inches long. These were buffed and polished, degreased, and coated with stop-off lacquer except for one inch square at the end of one side, and a small portion at the other end for electrical contact. These strips were kept in a desiccator until used. Immediately before being plated they were cleaned in a commercial alkaline cleaner, and rinsed in cold water. Steel panels were used throughout most of the work, since the thicknesses of the deposits could then be determined by the Magne-gage.

Current was supplied by a battery of Edison cells or, when a higher voltage was needed, by a 12-24 volt rectifier operating from three-phase, 220 volt alternating current. Current was adjusted by hand-operated rheostat. Voltages were measured by a voltmeter which was disconnected when not being read. Length of time of plating was chosen to yield a deposit approximately 0.001 inch thick.[3]

If current densities were below 1 amp./sq. in. it was necessary to give a "strike" of several seconds at about 1.5 amp./sq. in. to get a deposit started. After the strike, the lower current density sufficed to continue the deposition.

The anode was a perforated lead plate of about the same dimensions as the cathodes. The anode and cathode were contained, within the bath, in a Plexiglas cell whose inside measurements were 1 inch wide, about 5½ inches long and 2 inches deep. The cell was provided with holes to permit circulation and with brackets to hold the electrodes.

The panels, upon removal from the bath, were rinsed and dried; then half the plated surface was buffed and polished for use in the Tukon Tester.

Measurement of Hardness

Hardnesses were determined by use of a Knoop Indenter[5] mounted in a Wilson Tukon Hardness Tester.[6]

The hardness number is not independent of the applied load. That this is true is evident from Fig. 1 and Table XXI which were made from data on a single specimen whose estimated thickness was in excess of 0.006". This thickness is great enough so that the relative softness of the base metal does not influence the hardness of the deposit. Hardness determinations were made at various loads from 25 grams to 3500 grams. The hardness numbers drop sharply as the load is increased, up to about 1000 grams, and then remain constant with increasing load.

Peters and *Knoop*[7] recommend that the thickness of the deposits be a minimum of 14 times the depth of penetration, which is about 1/30 of the indentation length. For a deposit of 0.001", or 0.025 mm. thick the longest permissible indentation would be 0.054 mm. This length corresponds to a hardness of 244 for a 50 gram load, 488 for a 100 gram load, 732 for a 200 gram load, and 2440 for a 500 gram load. Since a softer deposit would give a longer indentation, these are the minimum hardnesses which can be safely tested at a thickness of 0.001" with the foregoing loads. A load of 500 grams or more on a deposit this thin is immediately ruled out, as none of the hardnesses are close to 2440. It would seem that the lightest possible load would be the most desirable; however, the resulting very short indentations are very hard to measure, even at high magnification. From these considerations, the load of 100 grams was selected for use in this work.

As a check, two series of deposits were made whose only variable in plating was time. One set was on steel, the other on copper. Knoop hardness numbers of the base metals, using the 100 gram load, were 192 for steel and 64 for copper. Hardness measurements were made on the deposits and thicknesses were measured on the steel-base set. In both sets the hardness numbers increased as the length of time of plating

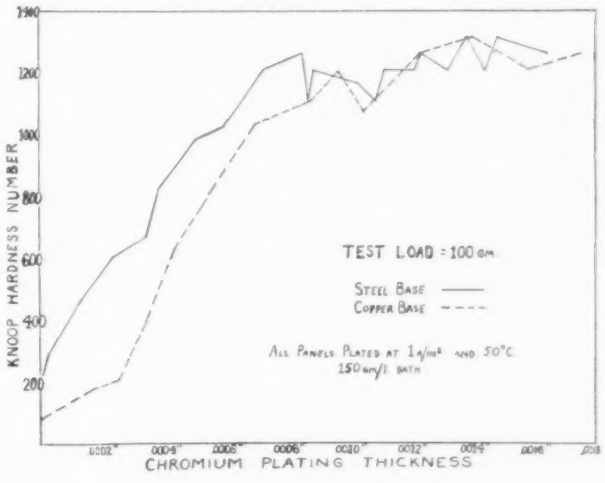

Figure 2.

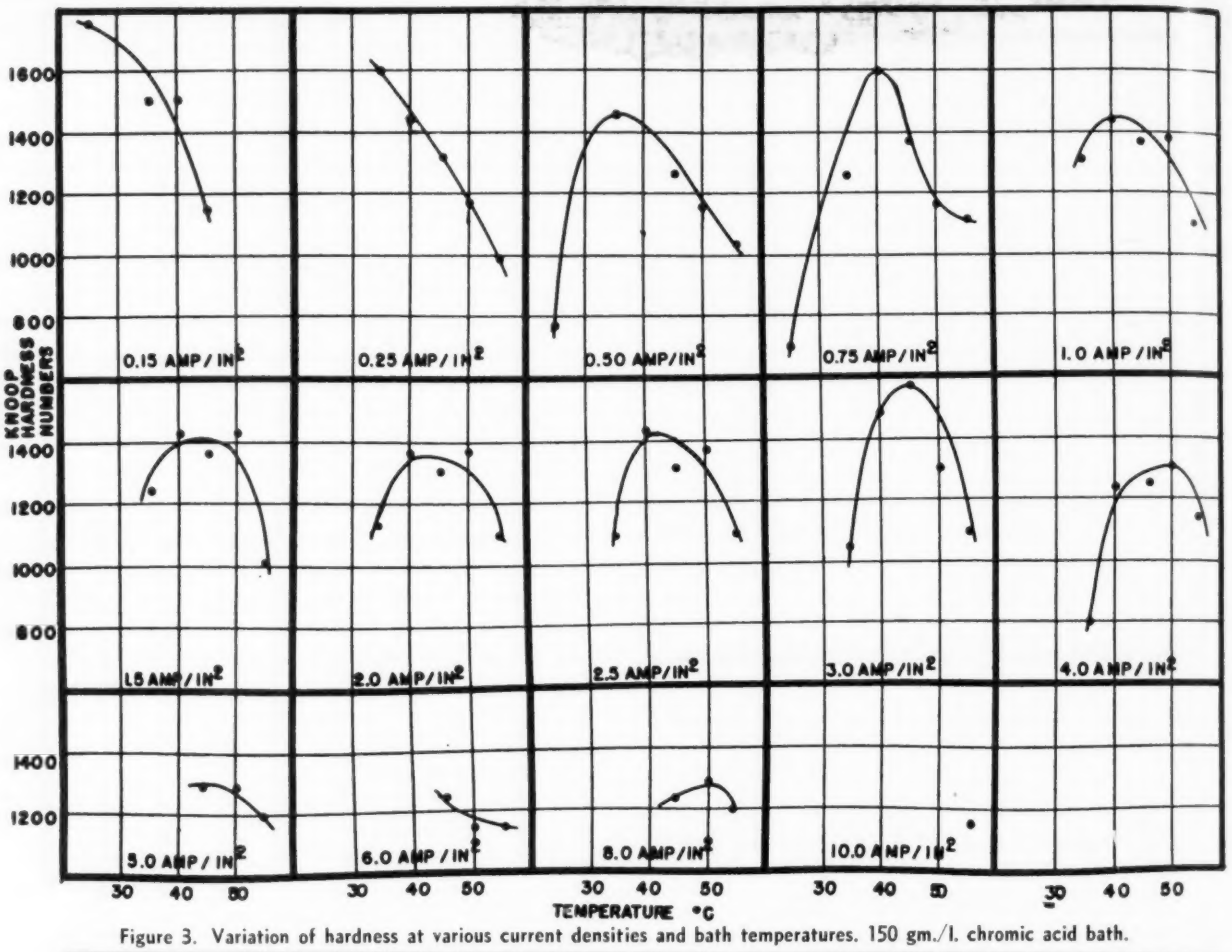

Figure 3. Variation of hardness at various current densities and bath temperatures. 150 gm./l. chromic acid bath.

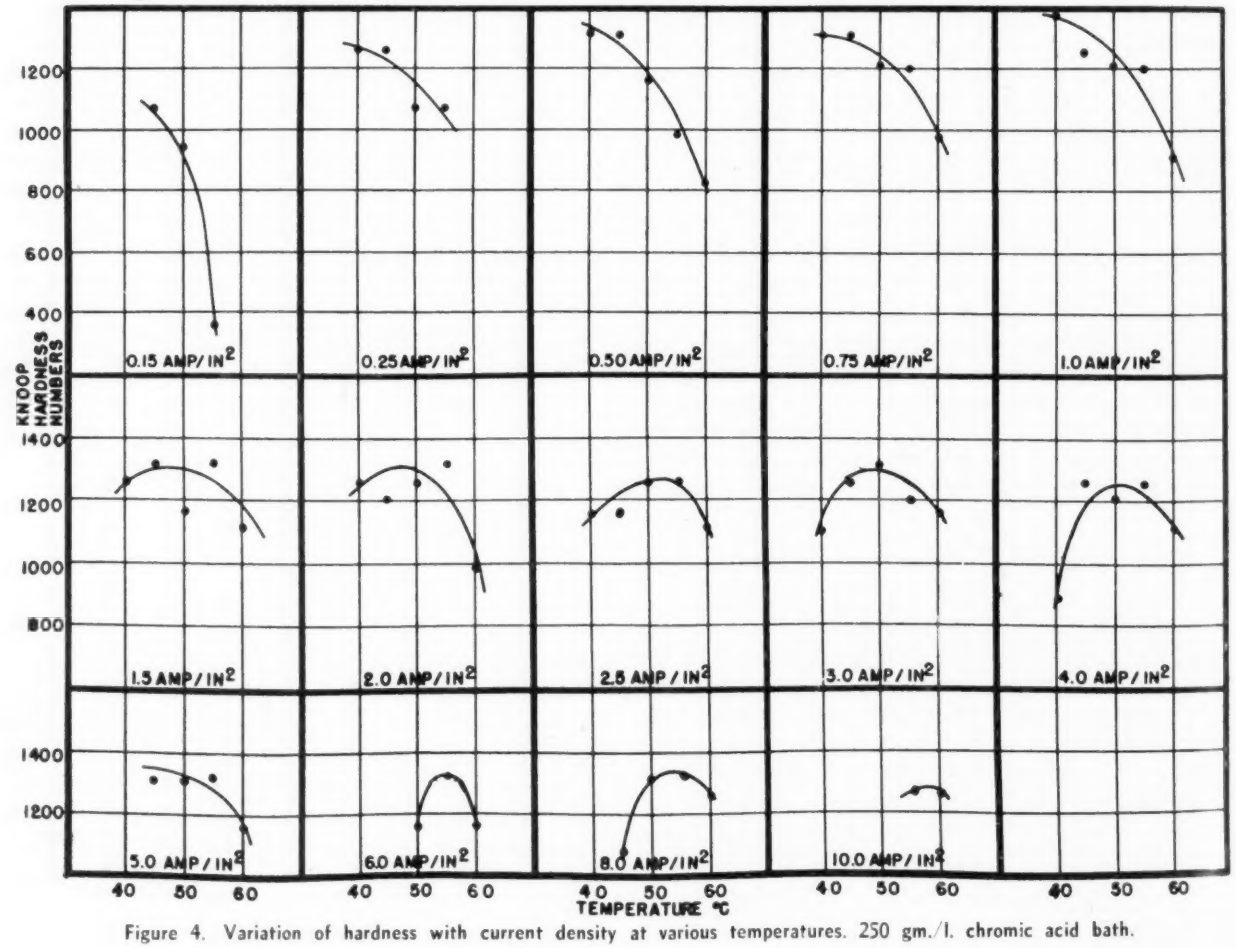

Figure 4. Variation of hardness with current density at various temperatures. 250 gm./l. chromic acid bath.

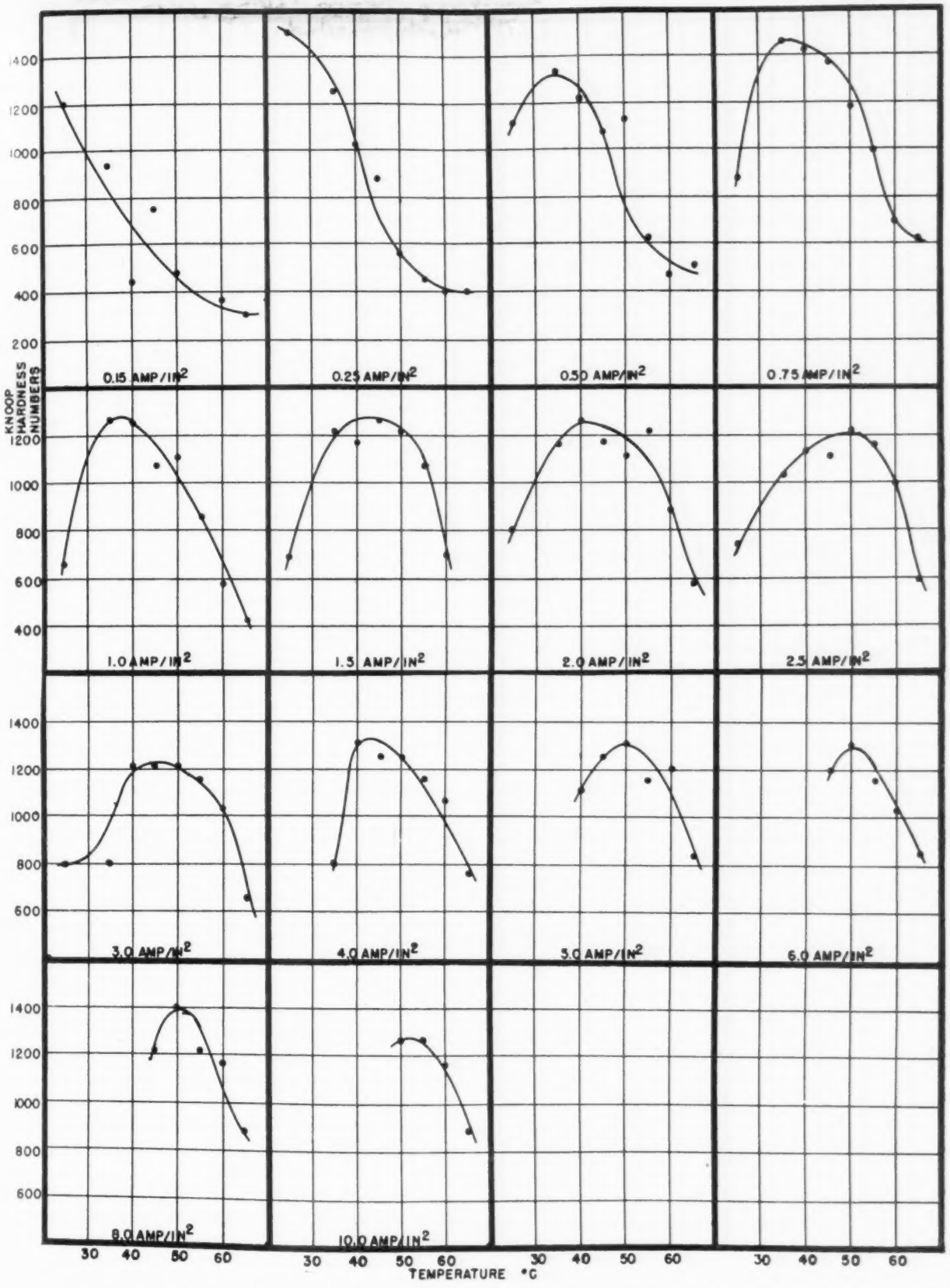

Figure 5. Variation of hardness with current density and bath temperature. 400 gm./l. chromic acid bath.

was increased up to about two hours plating time, after which the hardness number ceased to increase appreciably. Two hours plating, at 50°C. and 1 amp./sq. in. in the 150 g./l. bath, gave a deposit measured at 0.00073" on the steel base. This thickness, then, is great enough to minimize the effect of the base metal when the load does not exceed 100 grams. A greater thickness has negligible effect on the hardness. (See Figure 2.)

Every hardness number reported in this paper is the result of at least three indentations, made at the center of the polished section of the deposit, with at

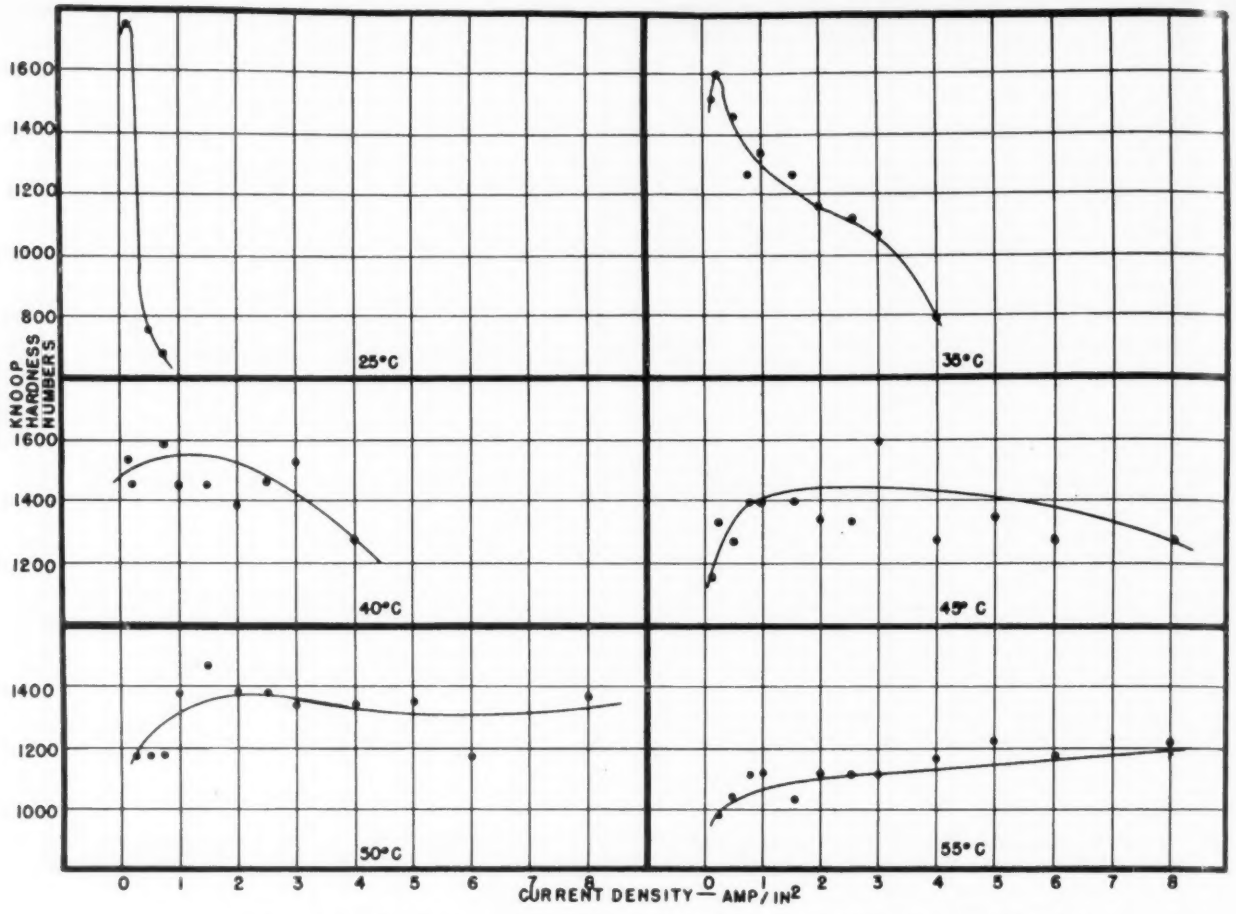

Figure 6. Variation of hardness with bath temperature and current density. 150 gm./l. chromic acid bath.

least three measurements of each indentation. All hardnesses, unless otherwise stated, are those obtained using the 100 gram load.

Discussion of Results

The hardnesses found in this study are plotted in two ways: Hardness vs. Temperature, in Figs. 3, 4, and 5; and Hardness vs. Current Density, in Figs. 6, 7, and 8. In some cases it will be noticed that there is considerable spread in the hardness values obtained, but generally they form a definite pattern.

In general, the hardest plates were those deposited at low temperatures and low current densities. An increase in either one of the variables caused a decrease in hardness. At any temperature and the accompanying optimum current density, an increase of either temperature or current density or both will decrease the hardness.

150 gm./L. Bath

The hardest deposit found in this study had a Knoop hardness number of 1752 and was obtained from the most dilute bath, 150 g./l., at the lowest temperature used, 25°C., and at a current density of 0.15 amp./sq. in. The current density appears to be quite critical at this temperature; a decrease to 0.10 or an increase to 0.50 amp./sq. in. decreased the hardness to less than half that of the 0.15 amp./sq. in. deposit. The effect of increasing the temperature was not as great, but the hardness was decreased. The effect of decreasing the temperature below 25°C. was not investigated.

At high current densities, elevation of temperature is necessary to get maximum possible hardness. This observation is in agreement with that of *Hume-Rothery*.[4] However, this maximum possible hardness shows a decrease as current density and temperature are increased.

250 gm./L. Bath

The hardest deposit obtained from the 250 g. l. bath was at the lowest temperature investigated, 40°C., at a current density of 1.0 amp./sq. in. This deposit had a Knoop hardness number of 1381. However, the shape of the hardness-temperature curves, Fig. 4, indicates that still harder deposits might be obtained at lower current densities than 1 amp./sq. in. if a lower temperature than 40°C. were used.

At current densities of 1.0 amp./sq. in. and below an increase in temperature lowered the hardness. Hardness-temperature curves at current densities in excess of 1 amp./sq. in. show definite but decreasing maxima in the range 45° to 55°C. as the current density is increased.

400 gm./L. Bath

From the 400 g./l. bath, the hardest deposit was obtained at a temperature of 25°C. and a current density of 0.25 amp./sq. in. The Knoop number was 1510. Here also the shape of the hardness-temperature curves, Fig. 5, indicates that perhaps harder deposits

might be obtained at a lower current density if the temperature range were extended downward. However, here, as in the 150 g./l. bath, the current density seems to be somewhat critical at this temperature, since with increasing current density beyond 0.25 amp./sq. in. the hardness decreases to a minimum at 1.0 amp./sq. in. and then increases only slightly with increasing current density. At high temperature, up to 45°C., the hardness increases rapidly to a maximum as the current density is increased; past the maximum the rate of decrease becomes smaller as the temperature is increased. At any temperature above 45°C., an increase in current density is accompanied by either a marked increase or no change at all in hardness. The maximum hardness at each temperature regardless of the current density employed shows a decline as the temperature is increased.

Concentration vs. Hardness

Cymboliste[2] observed that an increase in concentration of chromic acid in chrome baths causes a decrease in hardness. *Brenner* and co-workers[1] denied the existence of any such definite trend and presented data which apparently show no correlation between hardness and concentration. At 50°C and 20 amp./sq. dm. (1.3 amp./sq. in.) Brenner's standard (250 g./l.) bath gave a greater hardness than the concentrated (500 g./l.) bath. At 85°C., 20 amp./sq. dm. gave the same hardness from both the standard and the dilute (50 g./l.) baths, while 80 amp./sq. dm. (5 amp./sq. in.) produced a greater hardness from the standard than the dilute bath. At 100°C. and 80 amp./sq. dm. the deposit from the standard bath was much harder than that from the dilute bath. Our data show that a trend of decreasing hardness with increasing concentration does exist, but only in the low ranges of temperature and current density. At high temperatures and current densities the effect of increasing concentration is either nil or that of actually increasing the hardness. At a temperature of 40°C, the most dilute bath gave the hardest deposits so long as the current density was less than 3 am./sq. in.; above this current density the 400 g./l. bath gave the greatest hardness. At 50°C., the current density at which this inversion occurred was about 5 amp./sq. in. At 45°, the deposits from the dilute bath were hardest up to about 4 amp./sq. in. at which current density the concentration had no effect on the hardness. At 55° and 60° the 250 g./l. bath produced the hardest deposits throughout the range of current densities studied. It seems likely that, if still higher current densities and temperatures were to be used, the most concentrated bath would then produce the hardest deposits. Brenner's data, which he introduced to show the lack of any definite trend, agree with this view of the trend of hardness with concentration.

It has been mentioned that the hardest deposits are also the brightest.[3,4,8] Our studies have shown that the hardest deposits are those which have a satin appearance and are produced at current densities slightly

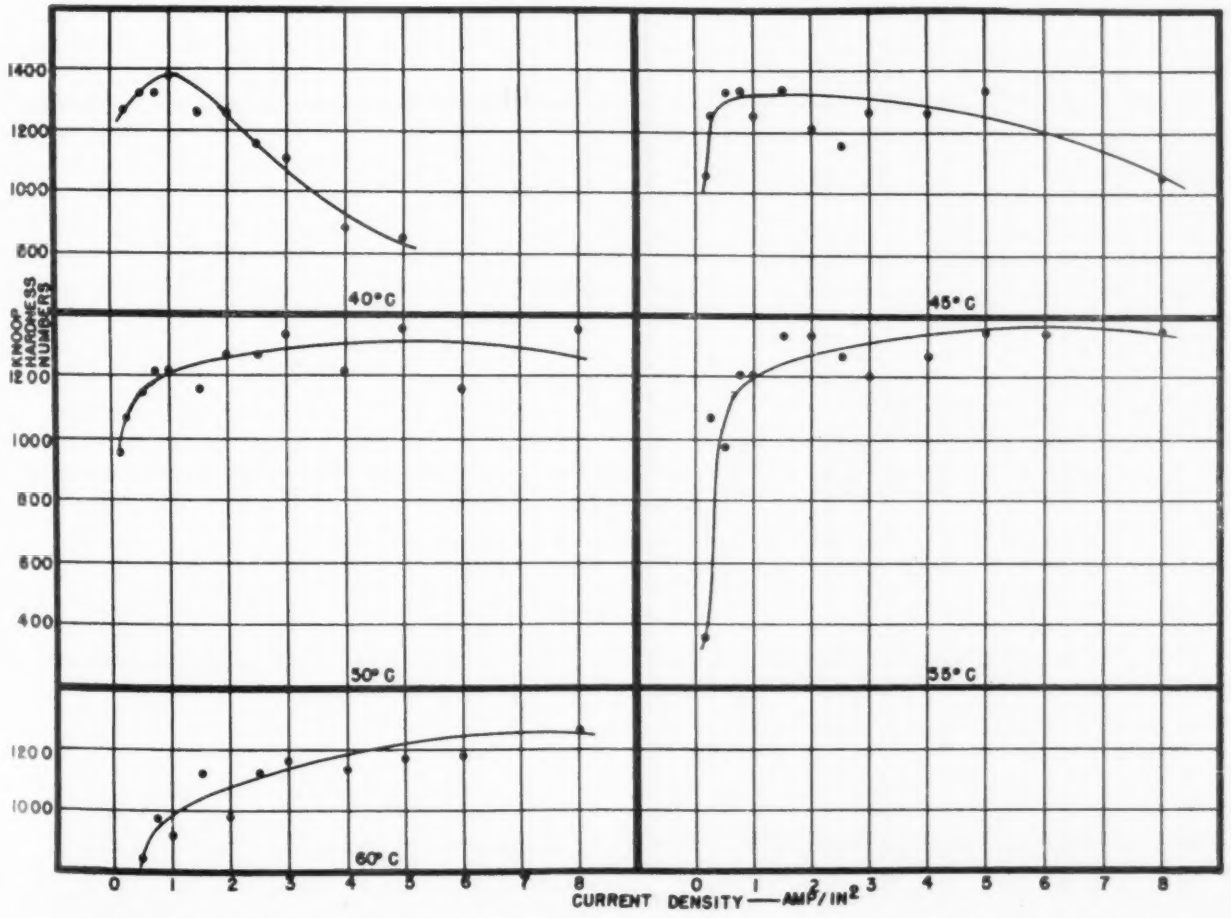

Figure 7. Variation of hardness with bath temperature and current density. 250 gm./l. chromic acid bath.

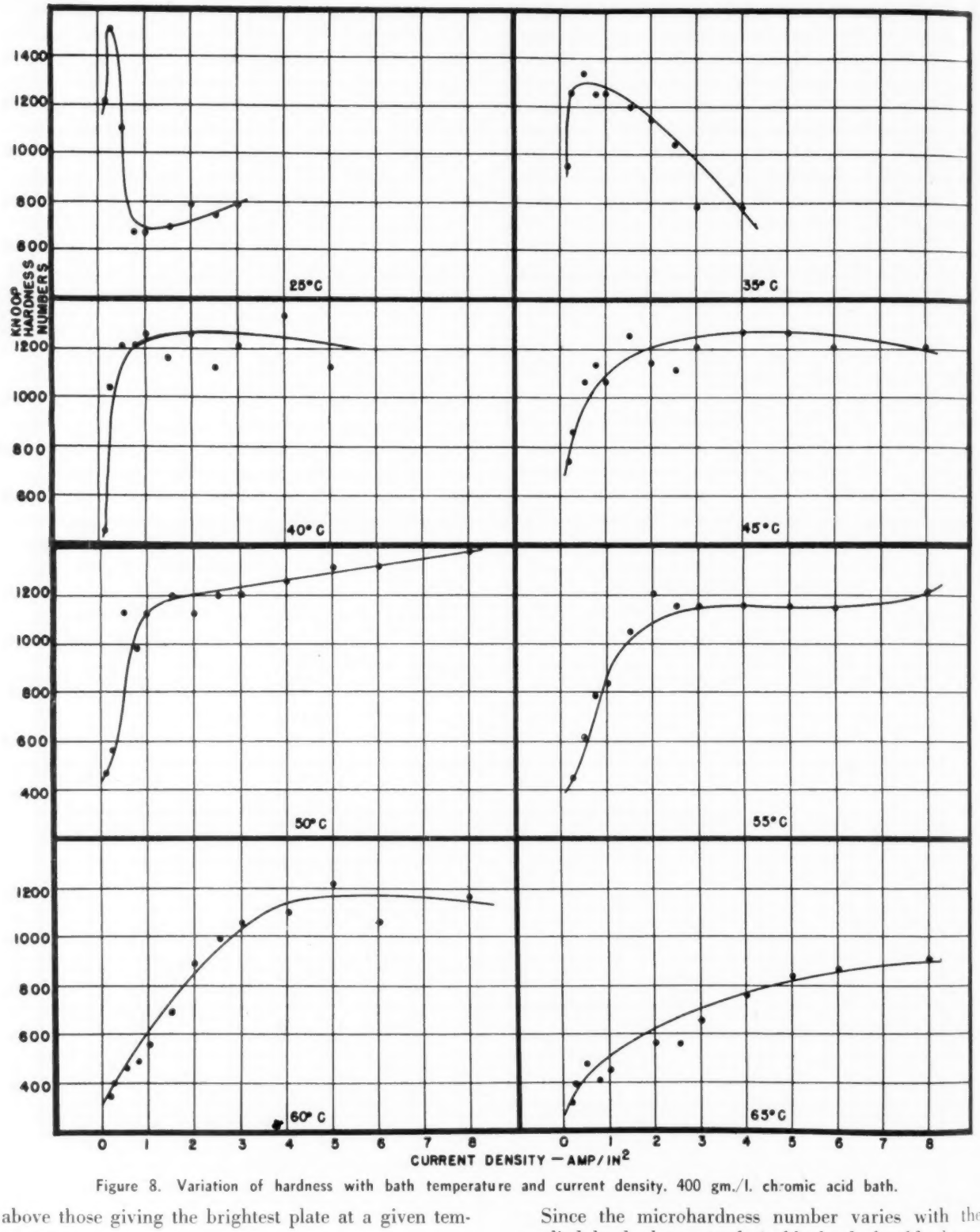

Figure 8. Variation of hardness with bath temperature and current density. 400 gm./l. chromic acid bath.

above those giving the brightest plate at a given temperature.

Summary

The hardest deposits are obtained at low current density, low temperature, and low concentration. However, the current density is quite critical and must be maintained accurately to realize the hardest possible deposit. In the temperature range 45° to 55°, a wider latitude of current density is allowable. At any temperature and concentration, the hardest plate is produced at a current density which is slightly higher than that giving the brightest deposit.

Since the microhardness number varies with the applied load, the most desirable load should always be determined for the particular type of specimen being tested, and this value should always be reported along with the hardness numbers.

Acknowledgement

Special acknowledgements are due *Beech Aircraft Corp.* for the loan of the Tukon Hardness Tester. The University of Wichita Foundation for Industrial Research for the use of their facilities, and *Dr. Lloyd*

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Strike Baths

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IN plating one metal on another it is generally required that the base metal be clean and have an active surface. The basis metal must be free of all dirt and grease, and it must be etched in order to obtain bond with an overlay metal. Very thin deposits may be deposited without bonding. If a very light coating of zinc, cadmium or tin is to be used as a temporary means of corrosion resistance for the basis metal then it may only be necessary to have a clean surface. However, for heavier deposits, or for thin deposits of higher strength metals such as nickel and chrome, blistering is liable to result if a good bond is not obtained.

A basic plating cycle then consists of:

1. Clean
2. Rinse
3. Etch
4. Rinse
5. Plate
6. Rinse

This is the basic cycle, but there are many deviations from it. For very thin deposits, steps 3 and 4 may be eliminated. For applications where bond is extremely important, step 1 may be expanded to several cleaning steps such as vapor degreasing followed by electrolytic cleaning. And in plating cycles such as electroplating on aluminum the process may become quite complex.

One of the common deviations from the basic plating cycle is the insertion of a strike step between steps 4 and 5. A strike step is inserted to promote bond. Electroplating of silver on steel is a good example of this. If a strike step is not used prior to depositing silver on steel from a silver cyanide bath the silver will not bond to the steel. If the steel is rough or deeply etched there may be some tendency to adhere, but if the steel is relatively smooth the silver may be stripped quite easily. If steel is to be plated with a high efficiency copper cyanide bath it is necessary to use a strike to obtain the same results as with a silver cyanide bath.

If it is desirable to deposit zinc on cast iron it is necessary to deposit another metal on the cast iron first, since hydrogen will deposit to the exclusion of zinc on a cast iron surface. A copper strike or a flash deposit from some other bath will overcome this difficulty. In the zincate process for plating on aluminum a copper plating step is used in order to bond nickel, chromium or other metals. In some plating processes the problem of covering in recesses may be solved by the use of a strike. The alkaline strike baths have high covering power and an overlay metal will often cover better over a freshly deposited intermediate metal than it will over the basis metal. The use of a copper strike prior to lead plating of steel is such an example.

A strike bath is often used when difficulties arise in plating due to a change in the quality of the raw material. The basis metal may have a cold-worked surface or some partially decomposed oil worked into the surface that will cause trouble. This may cause spotty or pitted plating with a bath such as a nickel bath that does not have inherent cleaning power. Although a strike bath may not be the best answer to this problem, it is often possible to keep the plating line going by the temporary use of such a step. In case of trouble a strike is often one expedient that is at hand.

The variations of a plating cycle are too numerous to go into in detail, and the word 'strike' is used so loosely that it is difficult to always state exactly what steps are strike steps.

For the purposes of this discussion it is prefered to define a strike bath as one that will promote bond or covering power. Thus it is a bath that has good properties for bonding to the basis metal, it has good covering power, and it is intermediate metal over which the overlay metal will cover and to which the overlay metal will bond. Although the strike bath does not always promote covering power, in itself it should be a bath that has good covering power. The main use of a strike bath is to promote bond.

In specific plating cycles it is possible that a great many baths may be used as a strike, but in general terms there are three specific baths that have wide possibilities for applications to a new plating process or for use in the event of trouble. These are: the low efficiency copper cyanide bath, the silver cyanide strike, and the alkaline tin bath. All of these baths are of low cathode efficiency, so that hydrogen is evolved during deposition of the metal, and all have high

The Author

throwing power and high covering power. The high throwing power is due to the characteristic increase in cathode efficiency with decrease in current density of alkaline or cyanide baths of low metal content.

Any of these low efficiency baths can be controlled by measurement of the cathode efficiency. This can be very easily and rapidly done by plating, followed by deplating and noting the point at which the deposit is completely removed on deplating.[1] The method has the advantage that the plating rate is measured and the amount of metal deposited is known regardless of the chemical analysis.

There is no fixed formula for a strike bath. A wide change in the bath formula may produce similar results. However, for a specific application it is necessary to set some chemical or plating limits on the bath in order to obtain reproducible results. The original formula for a strike may be chosen to meet a variety of conditions and although control is essential it is not as critical as in a plating bath.

An example of loose application of a strike is the addition of sodium stannate to a cleaning bath, where it is desired to tin plate steel with 0.02 to 0.05 mils of tin to obtain shelf life. If sodium stannate is added to the cleaner, tin will deposit as oil and grease is removed, and cleaning troubles will be lessened. This is particularly true where the tin plating is done from an acid tin bath. This is an example of adding strike properties to a cathodic cleaning bath. The opposite may be done also.

Where a copper cyanide strike is used a bath may be made that can be operated hot. By adding a strongly alkaline chemical to the hot strike, such as sodium hydroxide or trisodium phosphate, the strike will take on the properties of an electrocleaner.

It is rather unusual to use a bath for bath striking and cleaning, but it is occasionally warranted in high production—low cost applications.

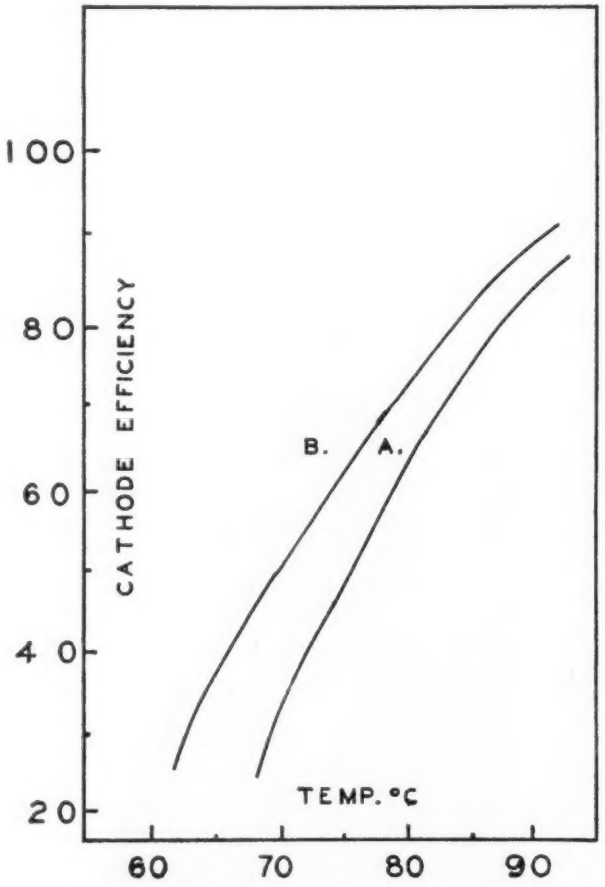

Figure 1. Variations in cathode efficiency with temperature in two alkaline tin baths.

Tin Strikes

The use of an alkaline tin bath for a strike is not common, but where it can be used it has the virtue that operation is very simple. The plating rate of the tin will increase with temperature, increase with tin concentration, and decrease with increase in alkalinity. However, if a temperature range is selected the bath

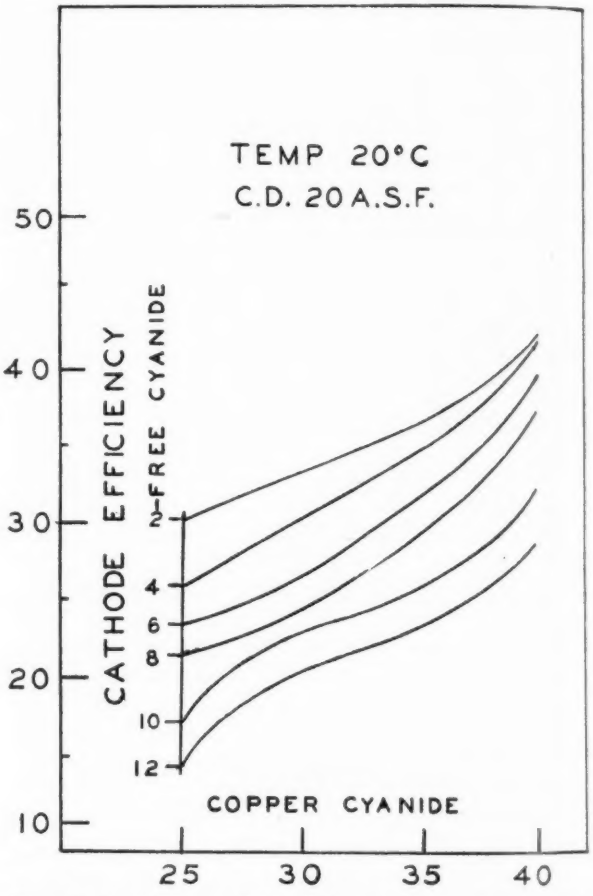

Figure 2. Variation in cathode efficiency with copper content and free cyanide in Rochelle copper cyanide baths.

may be easily controlled by control of tin content and occasional checks for sodium hydroxide content. If a low tin plating rate is desired it is easily obtained by low tin concentration and addition of sodium hydroxide to obtain sufficient conductivity. Conductivity should be sufficient to obtain a cathode current density of 40 to 70 amperes for square foot at 6 volts. Steel anodes may be used to keep the operation simple and to dispense with the need for sodium acetate in the bath.

Figure 1 shows the approximate variation of cathode efficiency with temperature of two compositions for tin baths.

Bath	*gm/l Sn*	*gm/l NaOH*	*gm/l Na_4O_5*
A	*25*	*15*	*50*
B	*20*	*8*	*50*

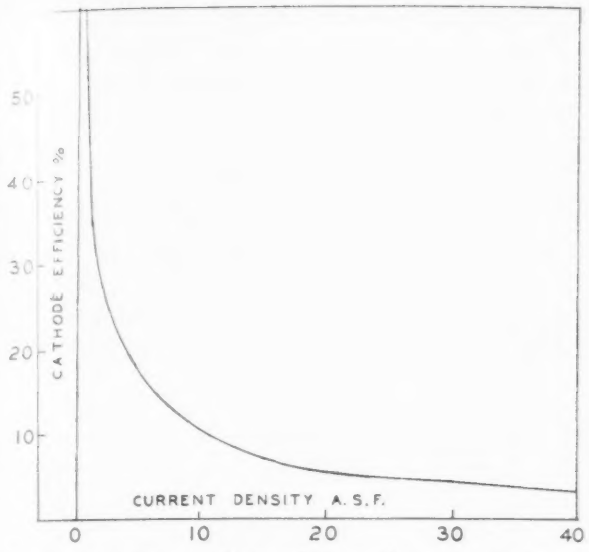

Figure 3. Variation in cathode effiency with current density in a silver strike.

The characteristic effects of temperature and sodium hydroxide are apparent on these baths. Even though bath "A" has a higher tin content than "B" it has a lower cathode efficiency, due to the higher caustic content.

The alkaline tin baths have the advantage that they are not at all critical as to chemical limits. A good deposit can be obtained over a very wide range of tin and caustic concentrations. However the cathode efficiency will cary widely with changes in the bath.

Copper Strikes

Copper can be deposited from a cyanide bath over a wide range of compositions. However, there are definite limitations on the bath. Unlike the alkaline tin baths, the quality of the deposit will change with change in bath conditions. In fact these changes are sufficiently marked that, for a bath that is held in narrow limits, bath changes can be detected by a plating range test. Quality changes in the deposit may take place but there are more serious limitations.

An increase in free cyanide in a copper bath will result in a drop in cathode efficiency. The cathode efficiency is highest at zero free cyanide, or at a ratio of 2 moles of sodium cyanide to one of copper cyanide. If the quantity of free cyanide is increased to 4 moles the cathode efficiency will approach zero. Thus the control of free cyanide is of greater importance than control of the metal content if it is desired to operate the bath at a known plating rate.

In order to control the free cyanide it is necessary to maintain bath balance. Bath balance can only be maintained by solution of copper from the anodes at the same rate that it is deposited. This is supposedly done by selection of the proper anode area and the proper ratio of copper anodes to steel anodes. Unfortunately this becomes quite a problem in low temperature baths, where the anode efficiency tends to be higher than the cathode efficiency.

Operation of a copper strike with steel anodes is not feasible, due to the tendency of steel anodes to polarize, due to oxidation of the cyanide at the anodes and due to rapid changes in the cyanide content.

Cathode efficiency control is desirable in low efficiency copper cyanide baths. By measurement of cathode efficiency and analysis of free cyanide the copper content can be estimated. At the same time the exact plating rate will be known.

Figure No. 2 shows the effect of copper cyanide concentration and free cyanide concentration on the cathode efficiency of low temperature Rochelle copper cyanide baths. The presence of Rochelle salts will change the plating rate, but not to a great degree. The Rochelle salts are added mainly to decrease polarization of the copper anodes.

Polarization of steel anodes can be inhibited by the addition of caustic to the bath.

Higher cathode efficiencies can be obtained in copper cyanide baths by the use of potassium salts. Although this can be done it is not desirable in strike baths. If the cathode efficiency approaches 100 per cent the bath will no longer function as a strike. Apparently a steel surface will become passive in a cyanide bath at 100 per cent cathode efficiency, and bond will not be obtained.

Silver Strikes

In many respects a silver strike is simple to operate, but control is critical. Operation is simple because the bath is relatively insensitive to current density and free from cyanide under the usual 6 volt operating conditions. Also, temperature does not have a marked effect on the plating rate, and steel anodes may be used.

Free cyanide has no effect on the plating rate of a silver strike. The cyanide concentration primarily determines the conductivity of the bath and may be selected for a wide, convenient control range. The addition of carbonate or hydroxide to a bath will increase conductivity without effecting the plating rate. Such chemicals could be added to increase the cleaning power of the strike, but the cleaning power will be poor regardless of the composition since the bath is operated cold.

In any of the strike baths there is some minimum of metal that is required for good results. In the use of the silver strike there is also a maximum of metal that can be deposited, since overplating in the strike step will result in a rough deposit.

For silver plating on steel the thickness of silver required in the strike step is of the order of .000006-.000012". This thickness can be deposited in 2 minutes from a bath of the following composition.

Sodium cyanide — 30 to 50 grams per liter
Silver cyanide — 1 to 1½ grams per liter
Current density — 50 to 100 amps per sq. ft.

Figure No. 3 shows the effect of current density on the plating rate for a bath containing 1 gram per liter of silver cyanide and for a plating time of one minute. It is seen that at high current density the plating rate increases very little. This means that the cathode efficiency drops as the current density is increased so that at current densities above 20 amperes per square foot the plating rate is essentially the same for all current densities.

The formula given is not necessarily a preferred bath. If the silver cyanide concentration is doubled the plating time may be halved. Thus the limits may

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Anode Maintenance in the Alkaline Stannate Tin Plating Bath

F. A. Lowenheim, *Research Chemist, Metal & Thermit Corp., Rahway, N. J.*

CONSIDERABLE experience in the investigation of field troubles and complaints with alkaline tin plating installations has led to the conclusion that one source of difficulty far overshadows all others in importance and frequency. It is no exaggeration to say that 90% of all troubles in stannate tin plating originate in improper anode control. Conversely, if the anodes are properly maintained and controlled, very few other difficulties are likely to be encountered. The obvious conclusion follows that if the plater thoroughly understands the properties of tin anodes and how to handle them, his tin plating worries will be over.

No originality is claimed for this discovery. Most writers on alkaline tin plating have mentioned the importance of anode control, and many have gone into some detail about it. But the very fact that anode troubles still occur indicates that these previous publications have not had their intended effect. Either they have not been read and understood by those platers to whom they were addressed, or the sections dealing with anode control have been so buried among the mass of other details concerning general operating data that their paramount importance has not been sufficiently stressed. This paper is therefore confined to a discussion of anode control in the alkaline stannate bath to the exclusion of all other considerations; not because these other considerations have no importance, but to emphasize the fact that without correct management of the anodes good results simply cannot be obtained.

The statements and conclusions to be expressed refer equally to the sodium stannate bath and the newer high-speed potassium stannate bath; they apply regardless of solution composition, temperature, or whether or not the solution contains acetate. They are true in general of a pure tin anode in contact with a solution containing free caustic alkali, which includes all commercial alkaline tin plating baths.

Why Tin Is Different

Except for chromium and some of the precious metals, metal plating usually involves the use of an anode of the same composition as the deposit, and it is the aim of the plater to keep anode corrosion in balance with cathode deposition so that the overall reaction in the plating tank is merely — in effect — the mechanical transfer of metal from one electrode to the other. The anode reaction is the exact reverse of the cathode reaction.

At the cathode: $M^{++} + 2\,e = M$ (1)

At the anode: $M = M^{++} + 2\,e$ (2)

The principal difficulty that may arise, with most metals, is the possibility of the anode becoming passive, so that instead of metal dissolution taking place, water is decomposed instead:

$$2\,H_2O = O_2 + 4\,H^+ + 4\,e \qquad (3)$$

When this happens, the bath becomes depleted of metal, salts have to be added, and depending on the particular metal and bath involved, various complications may ensue. In general, anode passivity is the only serious plating difficulty directly traceable to anode control (neglecting such factors as anode sludge roughening the deposits, etc.). This is true because most plating metals exhibit only one valence under the conditions obtaining in the solution. Thus copper shows only the valence of one in cyanide solution, and only two in acid solution; silver is always (for all practical purposes) univalent; and nickel, cadmium and zinc are similarly bivalent, with rare exceptions not encountered under the usual plating conditions.

This quick summary emphasizes the important fact that tin differs from these other metals, in that valences 2 and 4 are both common; and while it is true that in alkaline solution the 2-valent state is rather unstable, it

can persist long enough to cause a great deal of trouble.

Thus not two, but three, reactions are possible at a tin anode in alkaline solution. The tin may dissolve in the 4-valent state, in the 2-valent state, or not at all:

$$Sn = Sn^{++++} + 4\,e \qquad (4)$$

$$Sn = Sn^{++} + 2\,e \qquad (5)$$

$$2\,H_2O = O_2 + 4\,H^+ + 4\,e \qquad (6)$$

These reactions are written thus to make them comparable with (1), (2), and (3) above. Since we are dealing with alkaline solutions, however, it would be more accurate to denote them as follows:

$$Sn + 6\,OH^- = Sn(OH)_6^{=} + 4\,e \qquad (4a)$$

$$Sn + 4\,OH^- = Sn(OH)_4^{=} + 2\,e \qquad (5a)$$

$$4\,OH^- = O_2 + 2\,H_2O + 4\,e \qquad (6a)$$

Equation 4a represents the solution of tin as stannate ion, $Sn(OH)_6^{=}$: 5a the solution as stannite ion $Sn(OH)_4^{=}$; and 6a the decomposition of hydroxyl ion at the anode.

These reactions, as written, represent an overall process, not necessarily the mechanism by which it takes place. Thus reaction (4a) may be divided into two steps:

$$Sn + 4\,OH^- = Sn(OH)_4 + 4\,e \qquad (7)$$

(formation of hydrated stannic oxide),

followed by

$$Sn(OH)_4 + 2\,OH^- = Sn(OH)_6^{=} \qquad (8)$$

the solution of the hydrated stannic oxide in alkali to form stannate ion.

Reactions (4a) and (6a) represent the analogues of the generalized anodic reactions already considered. When tin dissolves as stannate, in the 4-valent condition, the bath operates satisfactorily; the cathode deposition is replenished by anodic corrosion, and tin plating is analogous to other plating. When reaction (6a) gets the upper hand, the anode becomes passive and tin does not dissolve: the net effect is that the bath is depleted of its metallic content and adjustments have to be made in the form of chemical additions. But in either case plating is satisfactory.

However, when reaction (5a) takes over there is trouble. The presence of bivalent tin, stannite ion, or stannous tin (to mention all the aliases under which this constituent is known) causes rough, spongy, non-adherent deposits; how bad the deposits are depends on many factors including how much stannite is in the bath. Small amounts of it can be tolerated — say up to about 0.5 g./l. of stannous tin (0.07 oz./gal.) — and may even be beneficial. But amounts appreciably greater than this cause immediate and serious trouble, and good work cannot be produced until they are destroyed.

One reason for the detrimental effect of stannite is its instability. Stannite in alkaline solution tends to disproportionate according to the following scheme:

$$2\,Sn(OH)_4^{=} = Sn(OH)_6^{=} + Sn + 2\,OH^- \qquad (9)$$

The tin resulting from this reaction, however, is not sound, adherent metal, but a powdery, non-adherent sponge. This explanation of the harmful effect of stannous tin may not be complete, but there is no doubt about the fact that stannous tin does cause unacceptable deposits.

The problem in the management of tin anodes thus boils down to ensuring that the anodes dissolve in the desired valence state, four, and do not dissolve in the undesirable valence state of two.

Using Peroxide or Perborate

Here it is appropriate to mention the function of hydrogen peroxide, sodium perborate, or other oxidizing agents used in alkaline tin plating. We have seen the evil effects caused by stannous tin, and we shall see that the way to avoid them is to keep the anodes dissolving in the 4-valent condition. If this desired end can be attained at all times, there is no need for peroxide. When, however, there has been trouble and stannous tin has formed, it is possible to correct matters by oxidizing it to stannate by the use of peroxide. This is the one and only function of peroxide in the stannate bath: it is a first aid measure. There should be no reason for its continued or routine use; a supply of it should be handy in case of trouble.

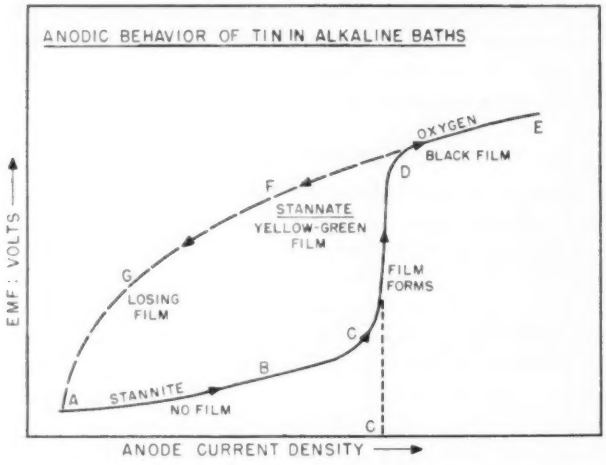
The Anodic Behavior of Tin

Let us consider what happens when current passes from a tin anode to an alkaline solution. In order to gain a better idea of conditions at the metal-solution interface, let us plot the potential drop across this interface as a function of the current density at the anode. Such a plot will take the form shown in Figure 1. As the current density increases along the line AB, the potential also increases, slowly and regularly, but always remaining at a relatively low value. All along this part of the curve the tin is dissolving as stannite, 2-valent tin: a definitely undesirable condition, as we have seen.

As the current density is increased still further, a point C is reached at which the potential rises suddenly (CO on the curve). Then if the current is further increased, the potential again rises slowly and regularly, but at a much higher level than before, along the line DE. The current density at which the sudden rise of voltage takes place is known as the critical current density. At current densities above this point, along the line DE, the tin anode will soon become passive and be covered with a dense black adherent film; under these conditions tin does not dissolve at all, the reaction at the anode being the decomposition of water and the evolution of oxygen, according to equation (6a).

Having reached this critical current density, C, and obtained the sudden rise in potential, let us now slowly decrease the current. The current-potential curve will be found not to retrace itself: instead, a new curve is traced out, along the dashed line DF, which is a continuation of the line DE in a downward direction. **It is in this region that tin dissolves as stannate.** The anodes acquire a yellow-green film, which to the experienced plater is a sign that all is well. This is the proper operating range.

If the current be now further decreased, along the line FG, a point will be reached where the potential drops more quickly, though not so suddenly as the rise on the way up, and the curve finally closes at the point A, from which it started. Along this portion of the curve the anodes lose their green-yellow film, and once more dissolve as stannite — we are back in trouble!



Effect of Operating Conditions on C.D.-E.M.F. Curve

It will be noted that the curve in Figure 1 is a generalized one — no numbers have been shown along the co-ordinates. In order to insert specific numbers, one would have to know the actual composition of the solution and the operating temperature. The effects of these variables on the anode curve are known, and can be summarized as follows:

Increasing temperature shifts the curve to the right (to the region of higher current densities); decreasing temperature shifts it to the left.

Increasing free alkali shifts the curve to the right: decreasing free alkali shifts it to the left.

The *stannate concentration* has a rather minor effect.

The *carbonate concentration* appears to have little effect.

The presence or absence of *acetate* has little or no effect.

The nature of the cation (that is, whether we are dealing with a sodium or a potassium solution) has very little effect.

Obviously, then, the two important variables are temperature and free alkali. For any particular values of these, there is an operating current density range for the tin anodes which is almost independent of the other factors. This conclusion has an important corollary: proper anode conditions have nothing directly to do with what is going on at the cathode — or to put it another way, one cannot properly speak of the "correct" anode/cathode ratio; this ratio is merely a conventional means of expressing a group of variables which in reality are interdependent in a much more complicated way. By juggling the composition of the bath, it would be perfectly possible to arrive at a condition where the proper anode/cathode ratio was 10/1, and equally possible to set up a bath where the proper ratio was 1/10.

The Practical Consequences

We have seen that unless the proper anode condition has been arrived at, the anode will either dissolve as stannite and spoil the work, or won't dissolve at all and the solution will become depleted in metal. How can one be sure of arriving at a proper condition, in practice, in a real shop (not the laboratory)? The operator must (1) learn to recognize the proper condition, and (2) learn how to attain it. These, of course, require some expansion:

First: *Learn to recognize the proper condition.* As a corollary to this, learn to recognize improper conditions. When tin anodes are dissolving in the desirable, 4-valent condition, they are covered with a green to yellow film; they are bright and clean. This film can be seen if an anode is removed from the bath for examination while the current is on. It does not persist very long after the current has been shut off, and consequently has to be re-formed after shut-downs.

This yellow-green film varies somewhat in intensity of color, depending on whether one is operating near the upper or the lower end of the safe operating range. If the current density is almost too high — that is, anodes tending to become passive — the film will be thick, rather dark yellow, and the metallic appearance of the underlying tin metal will be somewhat masked. When the current density is almost too low — film about to be lost — the film is very thin, and may show interference colors and iridescence.

As the current density is raised above the safe operating range, the anodes become passive and fail to dissolve, oxygen being evolved instead. Beginning at the high current density areas — usually the lower corners — the film becomes darker, ranging through tan, brown, and finally black, and this black film then spreads over the whole anode. This black film is, strangely enough, of almost the same composition chemically as the yellow-green one, but its properties are quite different. For practical purposes it is sufficient to recall that the color of the film is jet-black and that it is adherent. In fact, if the passive condition has been allowed to persist for an appreciable time, the black film will not redissolve in the plating solution and must be removed mechanically or by treatment with mineral acids such as muriatic.

At the low end of the scale, when the anodes are dissolving as stannite, they appear gray and metallic, or are covered with a smudgy, black smut. This black smut is a source of some confusion: the plater has read that a black film is a sign of too high a current density (see preceding paragraph), and mistaking this *black smut* for the above described *black film* he reduces his current density still farther; conditions get correspondingly worse instead of better! The two conditions, however, may be readily distinguished from each other: the high-current-density, passive black film is (1) adherent and (2) shiny, jet-black; the low-current-density lack-of-film shows itself as a dull smutty powder which can easily be rubbed off with the fingers.

When the anodes have this gray or smutty appearance, stannite is being formed in the bath; and if the work is not already being spoiled it soon will be. The immediate remedy is to treat the bath with hydrogen peroxide or other oxidizing agent to destroy the stannite already formed; and simultaneously to set about remedying the conditions at the anode to prevent the formation of any more.

How To Film Tin Anodes

It has been shown that in order to form the desirable film, a high current density must be impressed upon the anodes until the potential drop rises to the proper value; then the current is decreased to the operating range. The way to do this in practice will vary depending upon the size of the installation, the ease (or lack of it) of handling the anodes, and the characteristics of the DC power supply. There are several ways of forming the film; which to use depends on specific conditions.

In small set-ups, where anodes are light and easily handled, the simplest way is often to put the anodes in the tank one at a time, while current is on, with the rheostat at its proper setting for final operation. Thus the one anode in the tank will receive a current far higher than normal and will film immediately; the next, having no film, has a much lower resistance than the already filmed anode in the tank and will draw most of the current until it, too, acquires the film; the next unfilmed anode again draws more than its share until it films in turn, and so on as fresh anodes are added. Such a method is of course suitable only for rather small installations where the labor of handling individual anodes is not too difficult.

The more usual way is to have all the anodes in the tank, and to switch the current on: enough current must be available to reach the critical anode current density, which is greater than the operating current density. In other words, the generator must be capable of delivering more current than will normally be used. The current is turned on and the voltage raised; by observation of the ammeter it will be obvious when the anode film has formed. For as the voltage is raised the current will rise also, until suddenly the ammeter reading will fall — at this point the anodes have filmed over. Having been assured that the anodes are properly filmed, the operator can now adjust the current to the proper value.

Suppose, however, that this behavior of the ammeter needle is not observed? The proper procedure is to inspect the anodes: possibly they did film over, but for some reason the ammeter was not watched sufficiently closely. If the anodes turn out to have the film, all is well; if not, the indications are that the critical anode current density was not reached; and if no more generating capacity is available it will be necessary to increase anode current density by removing some anodes — that is, impressing the same current on a smaller anode area. Anodes should be removed until filming is observed.

These, then are the methods of filming anodes: place the anodes in the tank one at a time with the current on; or with the tank full of anodes, increase the current beyond the operating range until the behavior of the ammeter needle indicates that they have filmed over.

Two cautionary moves: it will be evident from what has been said that attempting to operate a tin plating installation of any but the very smallest sizes without voltmeter, ammeter and rheostat is not advisable. Second, contact between anodes and anode hooks, and between anode hooks and bus bar, must be clean and firm. A frequent cause of unfilmed anodes is poor contacts; those anodes not in good contact with the bus do not get their share of the current and remain unfilmed. For trouble to ensue it is not necessary that all anodes be unfilmed — *one or two dissolving in the unwanted stannite form can cause difficulty!*

Adjusting Bath Conditions

The operator sometimes has difficulty maintaining his anodes in the proper condition even after all the above precautions have been taken. If this occurs, it means that the operating conditions are not correct for the particular set-up involved. For example, if the anodes film over, only to lose the film within a short time, the indication is that the anode current density is too low for safety -- the conditions are just borderline. Some anodes should be removed, thus increasing anode current density alternatively, the bath composition may be adjusted to a lower free alkali content, or the operating temperature may be decreased.

Conversely, if the anodes gradually acquire the black passive film, it will be necessary to readjust bath conditions. More anodes should be added; or if this is not possible, it will be advisable to increase the free alkali concentration of the bath or the operating temperature, or both; or to decrease the total current. Which of these various steps should be taken will depend on the requirements in each case; for instance, if total current is decreased, the work will have to remain longer in the bath to acquire the proper thickness of deposit. In general, it must be remembered that these recommendations refer to anode behavior only. If secondary effects are observed — as on cathode efficiency for example — further adjustments will have to be made. Thus, decreasing the temperature — to take one example — might be one way around an anode difficulty, but this step also decreases plating speed. These interrelationships have been discussed elsewhere by the present author[1] and others.[2]

Recognizing Signs of Trouble

For uninterrupted production of good work from the stannate baths, proper anode operation is an absolute necessity. The plater should learn to recognize signs of incipient trouble so that he can correct them before they lead to serious difficulty. The bath can tolerate small amounts of stannite, and this fact allows the time necessary so that an alert operator can take the proper steps before conditions get out of hand. Here are some of the danger signals:

1—*Lack of foam around anodes.* Properly corroding anodes evolve small amounts of oxygen — it is not practical to keep them operating at exactly 100% efficiency. This oxygen evolution, together with the small amounts of organic matter usually present in a tin bath, causes foam. When the anodes are not foaming slightly, some platers speak of the bath as being "dead," which means, in effect, that there are no gas bubbles and the anodes are in all probability dissolving as stannite. In a few cases, where particularly pure chemicals have been used to make up the bath, the gas evolution is present but there is not sufficient organic material to form a foam; this condition is rare, but if suspected, a little foam builder such as oleic acid, rosin, etc., may be added to the bath. A slight foam blanket is desirable

anyway in order to reduce spray, which contains caustic and is irritating to operators.

2—*Low bath voltage.* The potential drop across the metal-solution interface of a tin anode covered with the proper operating film is of the order of 2 to 2½ volts. Other voltage drops around the bath circuit — bus bar losses, cathode polarization, ohmic resistance in the solution itself, etc. — are seldom less than 2 volts and may be considerably more. Consequently the operating voltage of a stannate tin bath is rarely less than 4 volts and may easily be as high as 6 or 7. When the voltage drops to 2 or 3, trouble from defilmed anodes may be confidently expected. Thus the experienced plater can often detect trouble by careful observation of the voltmeter.

3—*Test for stannite.* Test papers are available* which give a quick indication of excessive amounts of stannite ion. When trouble is suspected these are often helpful.

4—*Solution color.* A properly operating stannate solution has an appearance varying from water-white to straw, and may be clear to milky depending on how much colloidal matter is present. But if appreciable amounts of stannite are in the solution it will in most cases look grayish or darker; this is caused by the incipient precipitation of colloidal tin referred to above, (eq. 9) resulting from the disproportionation of stannite ion.

5—*Poor work.* The final result of stannite accumulation in the bath is spongy, non-adherent deposits, dark in color instead of the matte gray-white of sound tin deposits. It should be the aim of the plater to catch trouble before it develops to this extent; but even in this case, if the very first signs of poor work are noted and correction made immediately, not much harm will be done. Thus the plater should be alert for the first appearance of slight roughness of the deposits, and not wait until the work is totally unacceptable before taking corrective steps.

Barrel Plating

Everything which has been said applies with equal force to barrel plating; the only modifications required are those of emphasis. Usually in barrel work the anode current density tends to be too high rather than too low, due to the inability to introduce sufficient anode area into the small confines of the tank. Thus, one is more likely to encounter solution depletion than stannite troubles. Further, moderate stannite troubles often go unnoticed because the burnishing action of the barrel tends to rub off or smooth down spongy deposits. These considerations aside, barrel plating is no different from still tanks or automatics — the anodes don't know that the work is in a barrel instead of on a rack!

**From the writer's company and its distributors.*

Other Considerations

This discussion is not a complete operating manual for alkaline stannate tin plating solutions. Other troubles beside those at the anode can and occasionally do develop, but anode operation is far and away the outstanding cause of difficulty with these baths in practice. Nor, to repeat, is any originality claimed for these remarks; it is their aim to emphasize as strongly as possible the great importance of anode control. Other factors have been deliberately omitted from consideration.

A new "high-speed" anode has been introduced recently[3] which is finding its niche in the tin plating field. The remarks in this paper apply only partially to this new anode; in particular the "high-speed" anode is to a great extent free from difficulties with the formation of the film, since its operating range is above, rather than below, the critical current density. The necessity for maintaining the film, however, still remains. For the present the user of these newer anodes is advised to consult with their manufacturer or his agent concerning details of their operation.

Summary

Good work from the alkaline stannate bath — either sodium or potassium — is easily obtained provided proper anode control and maintenance are observed. Conversely, good work is almost impossible to obtain without such control.

Tin anodes differ in their reactions from every other common plating metal in that they can dissolve in two, almost equally likely, valence states; and only one of these states, the 4-valent or stannate tin, is desired; the other, 2-valent or stannite, causes immediate and serious trouble.

In order to ensure that the tin anodes dissolve as stannate, certain precautions must be taken. The anodes must be covered with the yellow-green film. The plater should learn to recognize the appearance of this film. He should also learn to recognize the signs of trouble, so that corrective measures can be taken.

The use of oxidizing agents — hydrogen peroxide and the like — is justified only as a first-aid measure. When such measures are required more than occasionally, fundamental steps should be taken to correct bath conditions.

A thorough understanding of the reactions of tin anodes in alkaline solution would be an invaluable aid to the plater in operating these otherwise very simple solutions.

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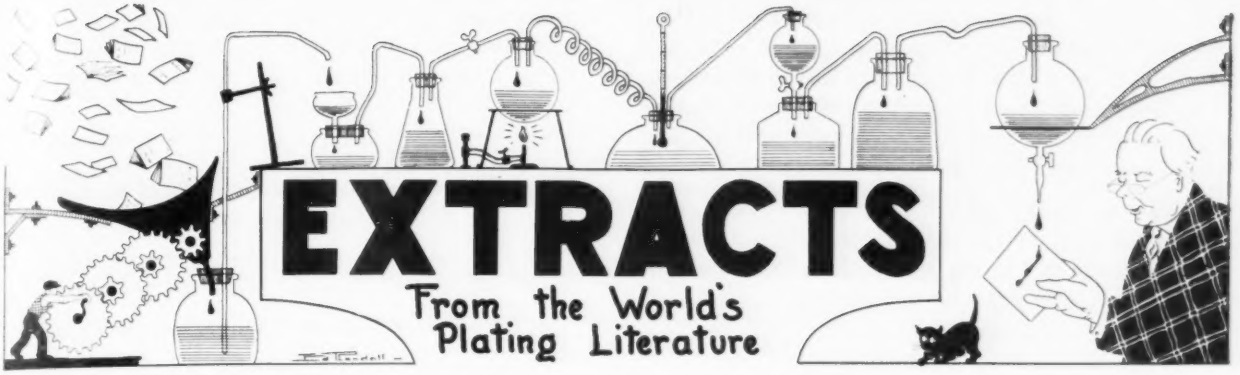

Relation Between the Metallic Boundary Surfaces and the Hydrogen Overvoltage

By J. O. Bockris—*Paper delivered at the 1950 International Congress of Deutschen Bunsengesellscheft.*

The author classifies metals into three groups, according to their effect on the hydrogen overvoltage, in which he takes as characteristic for each group special reactions which determine the hydrogen overvoltage. The first group comprises the metals mercury, lead, tin and thallium. The second group includes molybdenum, tungsten, nickel, iron and gold, and the third group platinum and palladium. The reaction governing the extent of the hydrogen overvoltage is, with the first group $H + e = H$, with the second group $H + H + e = H_2$ and with the third group $H + H = H_2$. The relations holding good for these various reaction mechanisms have been theoretically precisely calculated. A considerable agreement between theory and experiment exists.

Studies on Anodic and Cathodic Polarization of Metals

By R. Piontelli—*Paper delivered at the 1950 International Congress of Deutschen Bunsengesellscheft.*

The author and his co-workers have systematically investigated the relationship of the anodic and cathodic polarization phenomena under varying conditions. To prevent disturbances by the normal *Haber-Luggin* capillary, a hole was bored in the electrodes and the polarization measured over this. The following qualitative relations were found:

1. The anodic and cathodic current density-activation-polarization curves lie, in many cases, almost symmetrical to the static potential.

2. Deviation from this correspond also to other electrochemical characteristics, by which the ionic transfer reactions between the metal lattice and solution are of special significance. Of importance for assymetry are also anodic passivation or anodic or cathodic inhibition.

3. The electrochemical inertness of different metals resides less in their actual nature and much more in the nature of the bonding and the structure of the metal lattice and in the solution.

4. The heavy metals may be classified into the following groups: (a) Into electrochemical inert metals (Fe, Co, Ni, Cr, Pt, Pd, Rh), which are transition elements with incomplete electronic resonance. (b) Electrochemical normal metals (Tl, Pb, Sn, Hg, Cd), (c) Metals which lie between (a) and (b) such as Cu, Bi, Sb.

5. Anodic inertness can facilitate the assumption of passivation.

6. The most inert metals are the best hydrogen electrode and hydrogenation catalysts.

7. Inert metals form micro-crystalline and normal metals form macro-crystalline deposited structures.

8. Anions can act on the one hand as crystal growth inhibitors, and on the other hand as catalysers or inhibitors of the ion transfer reactions.

The Structure of Electroplated Metal Deposits

By G. J. Finch—*Paper delivered at the 1950 International Congress of Deutschen Bunsengesellscheft.*

The author investigated thin electroplated metal deposits of a thickness in general of less than 1 mu with the aid of the electron microscope. To reduce the influence of the foundation surface, the metals were deposited on amorphous materials, polished metal surfaces or semi-conductors. According to the conditions, there was obtained on the one hand a needlelike growth which occurred particularly at low temperature, low cation movement and rapid cationic impoverishment and on the other hand, an outstanding broadening growth tangential to the surface with high cationic movement.

These relations were discussed in considerable detail in the case of iron. The deposits with needlelike growth were brittle and less adherent and those with broadening growth were smooth and well adherent. With a single crystal foundation surface there always occurred first vertical growth of the deposit which passed with thicker coatings according to the conditions into the characteristic types.

The Structure of Electrodeposited Metals and Alloys

By E. Raub—*Paper delivered at the 1950 International Congress of Deutschen Bunsengesellscheft.*

The author first investigated the influence of polari-

zation on the properties of electrodeposited metals. The tests confirmed the assumption of Tammann, that the polarization increases the hardness in the case of electrodeposited silver. Other properties also of the electrodeposited metals change with the polarization during the deposition; the properties correspond somewhat to those of cold work-hardened metal.

Brightening additions increase the deposition voltage. Addition agents can act in a depolarizing manner thus for example, $K_2S_2O_8$ by which in addition, sulphides are formed in the metal. Most often, hydrogen passes into the deposited metal. The presence of inhibitors can lead to the inclusion of large foreign molecules in the crystal lattice. The content of foreign materials can amount to several per cent. Any widening of the lattice as is asserted to occur with such inclusions, was however found in no case by the author. Nevertheless, there clearly occurs textural and marked lattice disturbances in the deposits, which exert a considerable influence on the physical and chemical properties of the deposits. The occluded foreign substance further separate the metal lattice into smaller areas which can lead, in the case of the deposition of antimony up to the formation of explosive antimony. Investigations on the electrodeposition of alloys showed: Mixed crystals of Cu-Pb and Ag-Bi can be electrodeposited from the corresponding solutions while this has not been possible up to now with Au-Cu, Ag-Zn, Zn-Cd although mixed crystals of these systems are known. The author was able to deduce the following relations for the separation of mixed crystals from the cathode potential-current density curves: If the simultaneous separation of the two metals only results above the boundary current area of the nobler metal, then the metals separate out in two phases; this is without mixed crystal formation even when this is possible according to the constitutional diagram. If the simultaneous separation of the two metals however results below the limiting current area then mixed crystals are formed independent of the fact as to whether this is possible according to the constitutional diagram or not.

Anodic Polishing and Its Relation to Anodic Passivation

By K. Huber—*Paper delivered at the 1950 International Congress of Deutschen Bunsengesellscheft.*

The author reported on experiments on the anodic polishing of zinc, aluminum and magnesium in potassium cyanide and alkaline solutions respectively. As was shown by the increase in the voltage curves, the polishing always only occurs, when conditions for the passivation of the metal result. The passivation is thereby initiated by an oxide layer whose formation is facilitated by previously formed viscous fluid films. The thickness of the oxide layer amounts to about 100 to 200 Ångström. In order that a continuous current can flow, which causes the actual polishing, a material must be present in the solution which continuously redissolves the passivating oxide layer. This solvent process takes place particularly on the raised portions of the metal surface, by which these are gradually smoothed down. The polishing theories of *Jacquet* (Resistance theory) and of *von Elmore* (Diffusion theory) according to the author are not tenable and should be replaced by a covering theory in the above sense.

The Formation and Electrochemical Removal of Oxide Coatings on Metals

By F. Toedt—*Paper delivered at the 1950 International Congress of Deutschen Bunsengesellscheft.*

In the corrosion element platinum cathode - neutral electrolyte - unpolarizable anode the current flow is governed by the presence of oxygen on the platinum. As a result of exhaustion of the oxygen, the current rapidly falls. From the total current flow to the static condition of the current, there is provided a possibility of the measurement of the original loading of the platinum with oxygen. With corresponding measurements the oxygen loading of the platinum electrode was established up to 100 atom layers thick by which naturally, the separation so far as it is a question of molecular oxygen or of oxide, is not possible. If the platinum is loaded by anodic polarization then the oxidation equivalent produced by the discharge in the initially mentioned corrosion element can be quantitatively refound. Similar results were found with mercury and copper. If platinum, mercury, copper or nickel are previously loaded cathodically, results are obtained by the measurement in the corrosion element which clearly indicate a hydrogen discharge of the metal mentioned with the previous cathodic polarization.

Electrolytic Stripping of Plated Coatings

By A. Pollack—*Metalloberflaeche*, vol. 3B, No. 1, p. B8.

For electrolytic nickel stripping, use is often made of 78% sulphuric acid, the parts to be de-nickeled being treated anodically at 6-12 volts and 5-10 amps./dm.^{2}. A normal nickel coating is removed by this process in 10-15 minutes. To prevent attack on the base metal after the nickel is removed, inhibitors are used in the stripping bath. De-chroming is conducted in alkaline solutions which contain accelerating and inhibiting agents for base metal protection. The anodic treatment is 4-6 volts and 4-8 amps./sq. dm. Copper coatings are anodically stripped in 10-30% alkaline cyanide solutions. For de-tinning tinplate scrap, dilute sulphuric acid at room temperature or 20% caustic soda at 80°-90°C. is used at 3-4 volts and 1-2 amps./sq. dm.

Study of the Potassium Cyanide-Copper Bath

W. Savelsberg—*Metalloberflaeche*, vol. 3B, No. 1, p. B4.

In potassium cyanide copper plating operated on large scale production, it was found with newly prepared baths that the copper plate frequently showed porous places; on bent portions of the tubes being

(*Concluded on page* 69)

Estimating and Quoting Plating Prices

By Jerome L. Bleiweis, *Metal Finishing Consultant, North Hollywood, Calif.*

THERE are any number of systems and approaches employed by plating shops for the purpose of arriving at price quotations on jobs coming into the shop. Some systems attempt a complete cost analysis on each job as it is received. These cost analyses include estimates of direct and indirect labor costs and operating and non-operating overhead. A mark-up percentage is added to this cost to cover profit and other miscellaneous costs, and the figure so determined becomes the quoted price. This method of figuring is time consuming, frequently less accurate than is desired from so complete an analysis, and does not permit of "on the spot" estimates.

In a medium to large sized plating plant the ratio of labor and operating and non-operating overhead to gross sales is generally fairly constant over economically-stable periods of time. Where costs or prices drop or rise a new ratio may have to be calculated, which again will remain fairly constant over the next stable period. It should thus be possible to establish a price quotation system without resorting to protracted cost analyses. This system can be simple enough to allow fairly consistant "on the spot" estimates.

The price quotation has as its function not only the establishment of a price which will provide a profit, but at the same time the establishment of a price which is competitive — not out of line in either direction. What generally happens in practice, particularly on long run jobs, is that after a relatively short period of time the approach to the job is modified in the direction of increased efficiency and productivity, resulting in more profitable operation than was anticipated on the original quotation. Thus, the price quotation system should serve as a method of obtaining work for the shop through the presentation to the customer of reasonable and competitive prices. It is as fallacious a policy to greatly underquote as it is to overquote — witness some of the extraordinarily cheap work being performed today.

Very few jobs will be priced out of the market by the application of a sound pricing policy. If things are slow and there is a limited amount of work to go around, a systematic, widely-accepted method of quoting will ensure that at least whoever does the work will be doing it profitably. The alternative is that as much idle plant capacity will exist anyhow, and the operating capacity will be working at a loss or at a "break even" point.

Suggested Pricing System

The author instituted a price quotation system in a medium-sized job and contract plating shop about two years ago. The system has been used successfully as a method of quoting for the dual purposes of meeting competition and operating profitably. The figures used in the description below are the ones originally instituted. Some changes would naturally have to be made to cope with present day problems.

This plant was equipped to offer the following operations:

I—Polishing and Buffing

A—Polishing and buffing on all grades of set-up wheels, on all metals.

II—Plating (still tank plating only)

a—Copper
b—Nickel (bright)
c—Chromium (decorative)
d—Brass
e—Yellow gold
f—Flash or strike silver

III—Spraying

Clear and gold-dye lacquers, or upon request, special enamels, varnishes or synthetics.

IV—Burnishing

An explanatory note was appended to the above information for the edification of customers unfamiliar with the following:

A. Whenever chromium plating is specified, both nickel and chromium must be plated, and sometimes copper, nickel and chromium.

B. Frequently to achieve the required decorative standards for copper, brass, gold, or silver plated finishes, nickel must first be plated as an undercoat.

C. Zinc die-castings, regardless of the finally specified finish, must first be copper and nickel plated.

D. Aluminum and lead-base alloys will frequently require nickel undercoats to achieve the finally desired finish.

E. Nickel plated work submitted for further plating will not be accepted if the nickel plate has been passivated.

Pricing Units

The basic units defined for the price quotation requirements of this shop were:

Plating Tank Hour

Defined as follows: 5 sq. ft. x 6 cycles.

The plating tank hour is equal to the number of

Table I

Plated Metal	*Base Metal*	*Actual Plating Sequence*	*Price per plating Tank Hour (Nickel Plate = 1.00)*
copper	steel, brass, bronze, copper, aluminum, white metal, nickel plate	copper plate only	1.00
copper	zinc die-casting	copper, nickel, copper	1.75
copper	any	nickel undercoat then copper	1.10
brass	steel, brass, bronze, copper, aluminum, white metal, nickel plate	brass plate only	1.00
brass	zinc die-casting	copper, nickel, brass	1.75
brass	any	nickel undercoat, brass	1.10
srike silver	any	nickel undercoat, silver	1.25
nickel	any	nickel only	1.00
chromium	steel, brass, bronze, copper, aluminum, white metal	nickel, chromium	1.50
chromium	nickel plate	chromium only	1.00
chromium	zinc die-castings or any metals	copper, nickel, chromium	1.75
gold (24K)	any except zinc die-castings	gold only	1.25
gold (24K)	zinc die-castings	copper, nickel, gold	2.25
gold (24K)	any metal	nickel, gold	2.00

pieces which can be suspended in a 5 square foot area (2½′ long by 2′ deep for illustrative purposes) with reasonable plating tank spacing, multiplied by 6, which represents the number of 5-square-foot cycles which can be performed per hour. This unit applied for all cases where plating thickness was unspecified, or up to nickel plating thicknesses of 0.0003 inches, which was equivalent to 4-6 minutes of plate, the nickel bath operating with a plating rate of about 0.004″ per hour.

Illustration

For a flat piece of work one inch long by one inch wide, the number of pieces which can be suspended in a depth of 2 feet will be 15, allowing for reasonable work spacing. The number of rows of such work in a 2½ foot width will be 19, allowing for reasonable plating tank spacing. The products of the two ($19 \times 15 = 285$) represents the number of pieces of work in a five square foot area. Multiply this by 6 ($285 \times 6 = 1710$) and the result is the *Plating Tank Hour* for this particular piece of work.

Polishing Man Hour

This unit is equal to the number of pieces a good polisher or buffer can complete in one hour.

If the example of the above one inch squares is used and it is assumed that they are brass and are to be cut with tripoli and colored with lime, a polisher will be able to cut about 120 per hour and color about 240 per hour, or in three hours he will complete 240 pieces (240/3 equals 80). Eighty thus represents the *Polishing Man Hour* for this particular piece of work.

The Spray Booth Man Hour

This represents the number of pieces a man can spray in one hour. It is similar to the Polishing Man Hour.

The Burnishing Unit

This shall not be defined, except to state that for all work to be plated, if burnishing is required a 10% increase of the *Plating Tank Hour* shall cover this additional burnishing operation.

For straight burnishing work the number of pounds burnished per hour shall be considered to the *Burnishing Pound Hour*.

In the light of the above, a *relative price system table* was established for estimating prices on a Plating Tank Hour basis, nickel plate being taken as 1.00. For other metals the Plating Tank Hour was related to nickel by multiplying by the coefficient appearing in the table above.

A unit such as the *Plating Tank Hour* was determined by measuring the article involved. Units such as the *Polishing Man Hour* were determined either by (a) timing a sample performance, (b) on the basis of previous experience with analagous work, or (c) through a consideration of other jobs whose performance could be used as the basis.

It is possible to argue that, in defining the *Plating Tank Hour* the pieces are hung too deeply or too closely packed or that the unit tank chosen is too small, or too many cycles are presumed, or any other apparently impractical deviations from reality. It should be pointed out that the the unit is used only as a basis for price quotations and should be judged only on the basis of its use as a tool for competitive quotation, regardless of its apparent deviations from reality.

The established unit price per Plating Tank Hour, after some trials and comparisons with previously quoted prices, was taken as $10.00. The unit price for the Polishing Man Hour was taken as $3.00, or in special cases as high as $4.00. For the illustrated 1″ brass square above the quoted price for a buffed nickel plated piece would be:

$$\frac{1000}{1710} + \frac{300}{80} = 0.6 + 3.75 \text{ equals } 4.35 \text{ units.}$$

The quoted figure would probably be 4½ cents. If the

finish was to be gold on nickel the *Plating Tank Hour* (refer to table) would be 1.2, and the final price would be 3.75 plus 1.2 or 5 cents each.

Wholesale Rate Plan

One of the unique applications of this system was the introduction to customers and prospective customers of a plating Wholesale Rate Plan. This plan was directed at customers whose plating requirements were not excessive and whose production demands were not uniform. Instead of charging on a per piece basis, the Plan made available to the customer at a nominal rate a quantity of plating and finishing service specifically defined in terms of the units discussed above. A bulletin describing the terminology and including the definitions accompanied each contract.

In this manner a prospective customer, from a consideration of his monthly or yearly plating costs, could choose of the several contract categories the one which best suited him. This eliminated the necessity on the part of the plating company of having to quote and bicker over small lots, and it overcame any hesitancy a customer might have had to ship small lots to the plater whom he thought he might offend with a succession of small lots. The Plan became the focal point of a small lots clearing house. Where the fullest advantage of the Plan was taken, the customer gained on a "price per piece" basis; where the advantages of the Plan were not utilized the customer lost on a "price per piece" basis. However, in the long run, the net result was a gain for the customer who, on the whole, would choose the contract category which would work best for him on a "price per piece" basis. The benefits to the plating company were manifest. They succeeded in obtaining numerous small lot customers whom they ordinarily might not, and they eventually worked out a systematic procedure for centrally handling the small lots as they came in so that they acted as excellent "fill-ins" for slack production time.

The price system and Plan as described above were designed for a particular plating and finishing plant, and were limited to the requirements of this plant. However, by using them as a starting point they could be expanded to encompass most plating and finishing operations and perhaps lay the groundwork for establishing some uniform procedure for issuing price quotations, rather than the haphazard and sometimes somewhat "throat-cutting" procedures used today.

STRIKE BATHS

(*Concluded from page* 59)

be described as 2 to 3 gram per liter — minutes. That is 1 to 1½ grams per liter for two minutes 2 to 3 grams per liter for one minute and so on. The limits cannot be widened much beyond this unless multiple strikes are used, each strike being a little higher in silver concentration and operated at a little lower current density. The multiple strike method is often used. It may be safer, but it is not necessary if cathode efficiency control is used for a simple strike.

The limits of a silver strike can be established by a few simple experiments. If the strike is too heavy the strike deposit and the subsequent deposit over the strike will be too rough. If the strike is too light it will not be heavy enough to keep the basis metal active. A very thin strike, such as one deposited in ½ minute from a ½ gram per liter solution, will re-dissolve as the cyanide solution drains from the surface. If the plating time is increased to 1 minute it will take some time hanging in air for resolution to take place. For longer plating times the silver will not re-dissolve either on hanging in air or immersed in a cyanide bath.

Perhaps the silver strike limits can be shifted somewhat by changing the bath or the current density, but in any case the limits will be critical from a single strike bath and should be carefully controlled.

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EFFECT OF OPERATING CONDITIONS

(*Concluded from page* 56)

McKinley for his advice, cooperation, and encouragement throughout the study.

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ABSTRACTS

(*Concluded from page* 66)

plated, the coating was often rubbed off right down to the foundation metal (iron) on polishing. It appeared to adhere better on the straight portions. It was suspected that the marked stressing of the metal on bending had hardened the metal to such an extent so that bad adherence of the plated metal resulted. However, soft annealed parts also showed this appearance. Consequently the cause must be the electrolyte itself. The analysis of the bath showed a content of 20 grms./litre of Cu and 15 grms./litre of free KCN as well as some carbonate. It was suspected that divalent copper was present in such an electrolyte which acts in an unfavorable manner on the cathodically deposited copper, producing porosity by partial solution. The deposition voltages of electrolytes of various compositions are measured by means of a Sulfometer.

These were located at 2.85 volts; electrolytes however, in which $Cu^{\bullet\bullet}$ ions were suspected showed a change point in the current-voltage curve at around 2.02 volts, which apparently corresponded to the process $Cu^{\bullet\bullet} \rightarrow Cu^{\bullet}$.

Latest National Production Authority Rulings Affecting Electroplating Industry

See the February 1951 issue also for details regarding restrictions on Cadmium and Copper.

Nickel

(NPA M-12)
Amended Jan. 23, 1951

Effective March 1, 1951, the following list of items may *not* be electroplated with nickel. Items which were in process before Feb. 28, and which are completed before April 30, 1951, may be completed and nickel plated. Users of less than 250 lbs. of nickel per quarter are not affected by this ruling. Records must be kept of all transactions in nickel anodes *and chemicals*.

The items which may *not* be nickel plated are as follows;

COMMUNICATIONS:
- Escutcheon plates.
- Knobs.
- Name plates.
- Radio and television, decorative trim.
- Speaker grilles.

HARDWARE:
- Bells.
- Boat trim and accessories.
- Builders' finishing hardware (except half trim for bathroom and toilet side of door).
- Casket hardware.
- Chimes.
- Curtain hooks.
- Door catches.
- Door knobs.
- Door knockers.
- Drawer pulls.
- Harnesses.
- Hinges.
- Kick plates.
- Leashes.
- Letter boxes.
- Locks.
- Luggage hardware.
- Nails.
- Picture frames.
- Picture hangers.
- Push plates.
- Screen door and window hardware exclusive of screen.
- Screws.
- Switch plates.
- Tacks.
- Valve handles with the exception of bathroom and kitchen fixtures.

HOUSEHOLD APPLIANCES:
(Except parts subject to destructive abrasion and heat and except the strike prior to silver plating or vitreous enameling):
Including but not limited to:
- Food mixers.
- Heaters.
- Polishers.
- Refrigerators (except shelving and door handles).
- Washing machines.
- Waxers.
- Vacuum cleaners (except runners).

JEWELRY:
- Clocks.
- Alarm clocks.
- Costume jewelry.
- Lighters.
- Pens and pencils (except functional brass parts).
- Trim and optical glasses (except frames).
- Watches.

METAL FURNITURE AND FIXTURES:
- Commercial furniture, all decorative parts.
- Electrical fixtures.
- Home furniture, all decorative parts.
- Napkin dispensers.
- Store display cases.
- Store fixtures.
- Straw dispensers.

MOTOR VEHICLE (ETC.):
- Accessories.
- Dash panels (including instruments, controls and appearance items mounted in or on dash panels).
- Escutcheon plates.
- Gas caps.
- Gravel guards.
- Grilles.
- Horns.
- Interior trim.
- Lamp housing.
- License frames.
- Name plates.
- Ornamental trim around windows.
- Radiator trim.
- Trim rings.
- Wheel discs.
- Window levers.
- All other parts with the exception of window frames and slide channels, external and internal door handles, the bumpers, bumper guards, bumper bolts, hub caps, and exposed screws where no satisfactory substitutes are possible. The nickel employed for protection of bumper guards and bumpers should not exceed that amount equivalent to an average thickness of .001" on outside surfaces.

NOVELTIES:
- Ash trays.
- Coasters.
- Cocktail shakers and accessories.
- Clothing ornamentation.
- Cosmetic containers.
- Hair curlers.
- Handbag trim.
- Humidors.
- Ornamental buttons.
- Smoking stands.

PLUMBING:
- Basin supports.
- Cabinet trim.
- Soap dishes.
- Shower curtain rods and rings.
- Shower doors and trim.
- Tooth brush holders.
- Towel racks.
- Tumbler holders.

SHEET, STRIP AND WIRE PRODUCTS:
- All decorative parts fabricated from plated sheets, strips or coils.
- Bird cages.
- Clothes hangers.
- Display stands.
- Lamp shades.
- Shopping carts.
- Vending machines.

TOOLS:
- Drills.
- Flexible metal tapes (except measuring tape).
- Hammers.
- Office machines, and business machines, decorative trim.
- Planes.
- Pliers.
- Power tools (except for functional parts).
- Punches.
- Rules.
- Saws.
- Screw drivers.
- Wrenches.

TOYS:
- Bicycles (except handle bars, sprockets, spokes and hubs).
- Mechanical toys.
- Pistols.
- Toys.
- Trains.
- Tricycles.
- Wagons.

UTENSILS:
(Except the strike necessary prior to silver plating or vitreous enameling):
- Flatware.
- Hollow ware.
- Serving dishes.
- Serving utensils.
- Racks.
- Trays.

MISCELLANEOUS:
- Electric fans.
- Gambling equipment.

(*Continued on page* 111)

Establishing Finishing Operation Rates With Elemental Time Standards

By John S. Kelly, *Sargent & Co., New Haven, Conn.*

A PREVIOUS issue (Sept. '49) described how Sargent and Company, of New Haven, Conn., completely re-equipped their large production finishing department without interrupting the flow of parts to the assembly lines. The ripping out of brick walls and old equipment and the installation of new production methods and tons of equipment was a magnificent example of planning and scheduling. But it brought about another problem: all the new equipment and planned changes in methods rendered the twenty-five to thirty thousand active rates obsolete. A way had to be found to re-establish rates so these workers would be able to continue their level of earning, for it was known that the workers would quickly adjust themselves to the new conditions and keep parts flowing to the production lines.

This problem was fully realized when the new buffing jacks and backstand idlers were being ordered. It was obvious that hundreds of rates could not be established the morning the new equipment was put into operation. It was also recognized that in fairness to the men, they should be told their task when or soon after they started working on a part.

In order to develop the technique for studying work performed on the backstand idlers and to ascertain the expected belt life on various grades, grits and types of work, an experi-

Form G429 2/48

SARGENT & CO.
ELEMENTAL TIME STANDARDS ANALYSIS SHEET
LOOK - SEE - THINK

Dept. 21		Date 10/31/47	
Article Plumb Bob		Sheet No. 1	Of 1
Part No. 9B 206S.01		Analyst	
Part Name Body		Operator	
Operation No. & Name #6 Polish Six Sides on Grit Belt #80		Machine Type Backstand Idler	
		Machine No. 4852	

	LH	BH	RH	Get	Place	Time	F.	Total
1.	Get	Plumb	Bob from Tote Box	16-1		.007	1	.007
2.	Place	Plumb	Bob in holder held in Right Hand		16-41	.015	1	.015
3.	Regrasp	opposite	end of holder	5-1		.005	5	.025
4.		Place	part to wheel		5-11	.009	6	.054
5.		Place	down to wheel		5-11	.009	6	.054
6.		Place	across on wheel		5-10	.003	6	.018
7.		Place	up on wheel		5-11	.009	6	.054
8.		Place	out from wheel		5-10	.003	6	.018
9.		Visual	inspection of polished surface			.005	6	.030
10.	Get	Plumb	Bob in block to turn	5-1		.005	5	.025
11.	Place	Plumb	Bob part way up to turn		5-10	.003	5	.015
12.	Place	Plumb	Bob in position and drop in block		5-20	.005	5	.025
13.	Place	block	up to tip and release Plumb Bob (internal with element #14)					
14.			Get Plumb Bob	5-1		.005	1	.005
15.			Place Plumb Bob in box		16-21	.013	1	.013
16.			Get block from Left Hand	16-1		.007	1	.007
17.								
18.								
19.			Remove work					.0010
20.			Get work					.0010
21.			Belt change			2.65	1000	.0026
22.								
23.								
24.								
25.								
26.								
27.								
28.								
29.								
30.								
31.								

Gaging Frequency	Base Time/Piece .3696 Min.	Pieces/Hour	Pcs.
Tool Change Frequency	Allowance %	Labor Grade	
Previous Base Rate	Std. Time/Piece Min.	Base Rate	
Previous Price/C	Hrs./C Pcs. Hr.	Price/C	

Figure 1. Example showing the description and analysis of the motions of a simple part worked out as far as the base time.

mental backstand idler was shipped in early, and set up in a test room.

Typical parts were sent to the experimental room for analysis. Two experienced polishers were alternated to perform the work. A Methods Engineer who had at one time been a Class A polisher was assigned the task of developing the method of setting rates on the new equipment.

Elemental Time Standards System

The Methods and Standards Dept. of Sargent's has recently changed from the old-fashioned system of setting rates by the stop watch to Elemental Time Standards on all operations in the factory except polishing and buffing. This system has many advantages over conventional time study. Possibly the most outstanding feature is that it develops task for the "normal" operator. Studies do not have to be leveled, for there are no watch readings. It is based on the time required to perform motions. A rate is automatically adjusted for normal, whether the operator is performing at 90 or 110% efficiency. With this system, an operator is assured of the full time allowance required to perform every necessary motion of a job.

When the backstand idler development work was started, it was known that all the handling, dressing and "to wheel" times could be established by the "Get" and "Place" time values of Elemental Time Standards. For the two previous years, research had been carried on to standardize wheel time on an area basis for polishing, in an effort to establish standard data. It was at first thought that the wheel times would have to be watch-recorded times until the area standard data could be completed. Nevertheless, while compiling the standard data, experiments were conducted applying the distance and pressure values of Elemental Time Standards to establish wheel times. In less than a week, sufficient proof had been established to demonstrate that the new E.T.S. system was more than workable. It resulted in a better finish and served as an excellent record of the work performed, both for quality control and operator instruction. The area standard data was completely dropped.

The new E.T.S. system was developed to establish the wheel times as well as all handling for buffing, coloring, dry scouring and wet scouring studies.

Cost Saving Methods Used

Polishing work on parts or various surfaces of parts was analyzed on the basis of the skill required to perform the work. The routing of the work was planned so that only the most difficult work or surfaces were performed by the top-skill, highest base-rate men. Less difficult work was done at a lower base-rate. This same break-down applied to the buffing.

It was also found advisable to keep the men as far as possible doing work on the same grit belt. This reduces the change-overs. The operators do not have their rythm of motions interrupted. It results in higher productivity and earnings for them.

Another motion conservation step used on small pieces was to have a cut-down wheel together with a separate coloring wheel on the same shaft. This enables a man to finish polish, cut-down and color with only one handling of the part.

The technique for establishing fair, consistent base times had been thoroughly standardized with the work in the test room. Actually it had been developed to such an extent that rates for most regular work could be set at the desk, with assurance that the operator would be compensated for all work required.

Group vs. Individual Incentive Plan

The problem that had to be decided next was, "How will the new method of pay be set up?" The operators' cooperation was necessary. It was natural for them to wonder how they were going to make out with entirely new equipment, methods and rates. And of course, as operators always do, they had heard a rumor that they were going to be asked to work in a group.

It was decided that a fair approach would be to use a high guaranteed rate for the groups, with an additional bonus possible with more production. This would enable them to earn approximately their past total average or more.

There were only two stipulations. First, that quality work only would be paid for. Any below standard work which was the group's fault had to be done over without credit. The second stipulation was that when new people, not fully experienced, were assigned to the group with their work credited to the group without having their time charged, there would be a temporary ceiling equal to the high guarantee plus the bonus. Of course an experienced worker would become a fully participating member instantly.

Figure 2. This work place was developed for laying out and protection of lacquered work going to the assembly lines. The bench is on two levels; low level for work to be done, higher level for trays being filled, center for supplies of paper. Rubber matting under workers feet lessens standing fatigue.

Payment was by the standard hour method, paid by the week for quality acceptable parts finished and shipped, or ready for shipment, out of the processing area.

Results Obtained

The exceptional value of the new method of establishing rates was demonstrated after there had been a reduction in personnel during an off-season. A tremendous increase in production was needed. The man power had to be increased and spread over two shifts. Experienced men could not be hired. They had to be made,—fast.

The new system of setting rates details every motion into a series of "Gets" and "Places". The wheel time is described as a series of "Places". This enables the foreman or methods engineer to describe to a new operator exactly how many times to pass the part over the belts to produce the desired results.

The best proof is that production schedules were met and workers earned bonuses.

Figure 3. Special work benches for laying out work for flat lacquering machine. Degreased parts in upper tray are wiped by gloves of operator, then placed for complete lacquer coverage in lower tray. Filled trays are taken by spray machine operator, or a sheet of paper placed over filled tray for storage.

Production Scheduling

Finishing in the hardware business presents a difficult problem in that one part may be finished in as many as seventeen different finishes. They all have to be produced when and in the amounts called for by Production Control. Sargent and Company uses the route card process control throughout the plant. This means that each part, when it enters the finishing department, has to be covered with a set of route cards showing the sequence of operations and prices for every finish. There are many thousand different parts to be processed during the year.

A special process sheet was developed to be used in the Finishing Dept. This enabled one or two sheets to replace 10 to 50 cards. An added feature was the totaling of standard hours by groups, which greatly simplified time keeping.

The last group to be established was the most complicated. It included degreasing, wiping, laying-out, lacquering, wrapping, packing, and all necessary carrying. With the old method of dip lacquering and steam oven drying, work had been strung, dipped, dried, unstrung and packed in boxes or on pin boards. There had been no standardization of work place area. The people had to move to the work and set up a temporary work place.

The first step was to analyze what work had to be performed at each station. When each motion required had been recorded, work stations were developed to bring each movement to its lowest motion classification. See figures II and III. This eliminated all the long reaches and back motions which are so tiring to an operator. While the work benches were being built in the carpenter shop, work sheets were developed for the different type jobs.

An E.T.S. work sheet (Figure I) is a new type of standard data. Instead of taking and leveling ten, a hundred or a thousand studies, one analysis is taken with Elemental Time Standards. The fundamental total times for groups of required motions as established according to controls such as Class "Gets", Class "Places", distances, weights and frequencies are all presented on the work sheet. The typical factors of a part to be studied are marked on the sheet and the study is completed.

Calculating Rates With Elemental Time Standards

A slight study of the pictures of the work places and controlling work sheets plus an explanation of a simple example will reveal how rates can be set rapidly, accurately and consistently at the desk.

The Wrap and Pack work sheet for a typical part is shown as an illustration. (See Figure II.) The work grouped under number 1, "Get empty tote box, remove old cardboards from box, place one in and remove full box of work," has had a time of .6010 minutes assigned. Frequency is the number of pieces packed in a box. The analyst therefore writes in this instance 1 for 300 under the Frequency column and calculates the time per piece. Number 2 which is "Getting, positioning, turning and removing the tray" has the assigned time value divided by the number per tray. Number 3 has seven possibilities. The 16-1, 16-2 and 16-3 indicates the sixteen inch average reach required and the three classes of "Gets." The quantity indicates whether the operator gets one or two pieces at a time. The man making the study simply checks the condition required by the part and has the time. In rare occasions where the parts are of unusual design, the motions are analyzed in the form on the right side of the box to find the allowed time. Number 4 covers the size of the wrapping paper and number of folds

Dept. 21 — Date 4-7-49
Article — Sheet No. 1 of 1
Part No. B - P 155 All Finishes — Analyst
Part Name Rose — Operator
Operation No. & Name WRAP AND PACK — Machine Type Bench

	Time	Freq.	Time/Pc.
1. Get empty tote box, remove old cardboards from box, place one in and remove full box of work. Freq. = Number per box.	.6010	1/300	.0020
2. Get tray of work, position tray for minimum reach, turn tray when ½ completed and remove empty tray. Freq. = Number per tray.	.3480	1/45	.0077
3. Time per piece to get and place parts on paper.			

Qty.	16-1 / 16-21	16-2 / 16-21	16-3 / 16-21	LH	BH	RH	Get	Place	
1	.0200	.0240 ✓	.027						.0240
2	.0180	.0200	.050						

4. After the operator has placed the material to be wrapped on the paper: She performs the complete wrapping operation including grasping the finished package and preparing to dispose of it.				
Paper Dimensions Including	8" x 8"	16" x 16"		
One fold made	.040 ✓	.054		.0400
Two folds made	.048	.062		
For each additional fold Add	.008	.008		
	Place	Time		
5. Place parts in box	24-21	.017		.0170
6. If it is possible for operator to make her original "Get" of the paper internal with the place of the last piece of material on the paper.		Sub Total		.0907
Subtract	.008 ✓	.009	—	.0080
			Total	.0827
7. Allowance 5%.				x 105%
		Total Base Time/Pc.		.0868

vl

Previous Base Rate	Base Time/Pc. .0868	Min.	Pcs/Hour 628	Pcs.
Previous Price/C	Allowance 10	%	Labor Grade 10	
Note:	Std. Time/Pc. .0956	Min.	Base Rate .99	
	Hrs/C Pcs. .159	Hr.	Price/C .158	

Figure 4. Wrap and Pack work sheet, giving complete analysis of all factors involved in the operations.

made. The box which describes the established method is checked. That time is written in the time per piece column. Number 5 covers the disposal or placement of the wrapped part in the tote box. Number 6 is used when "Getting" the corner of the paper is simultaneous with "Placing" the work on the paper and the time value for the size paper is subtracted from the Subtotal to find the total. Number 7 is a 5% allowance added as a result of delay studies to cover the interferences occuring when the operators are being serviced and when they have to replenish their supplies. The total time raised to 105% equals the Base Time per Piece. The rest of the calculations are the normal steps used in arriving at a rate either as price or standard hours per hundred pieces.

Advantages and Results

Of even greater value than the tremendous time savings of these work sheets is the consistency of the rates. The operators know that the same application of skill and effort will always result in their same level of earnings. This does away with one of the foreman's greatest problems. There are no "tight" or "loose" rates that he has to watch, to see that they are equally divided. He can move any job to any operator and know the operator's or group's earnings will not be effected.

Many doubts and questions may be answered at this point by a few simple statements of resultant facts.

I. Required production per man hours was considerably raised.

II. Workers made bonuses.

III. Quality was maintained or increased where necessary.

IV. Training became remarkably efficient.

V. Grievances over rates now were reduced to a factual discussion over, "What did you do? What was the condition of the incoming part? Has there been a change in the quality standard?" The analysis could be reviewed by motions and quality descriptions compared. No change in work equalled no change in rate. A change in work or quality resulted in an instant change in rate or a special allowance for a run of poor stock. The workers not only like the system, but are getting motion conscious enough to be good timber for time study men.

Abrasive Methods—Surface Treatments—Control
Electroplating—Cleaning—Pickling—Testing

Shop Problems

METAL FINISHING publishes, each month, a portion of the inquiries answered as a service to subscribers. If any reader disagrees with the answers or knows of better or more information on the problem discussed, the information will be gratefully received and the sender's name will be kept confidential, if desired.

Pitted Cadmium on Aluminum

Question: We are forwarding for your examination several aluminum parts that show pitting after cadmium plating. Our cycle also includes a nickel strike before cadmium, and we filter the cadmium bath. Can you give us any clues as to what can be causing our trouble?

I. M.

Answer: It is difficult to say whether the cadimum or the nickel plating is causing the pitting. You can check this by stripping off the cadmium in an ammonium nitrate solution to see if the pits disappear. If not, then the nickel strike is at fault, and the usual remedies, such as peroxide additions to dull baths and anti-pit agents to bright baths, can be tried to eliminate the pitting. If the pitting is due to the cadmium plating, it is possible that you are introducing air bubbles into the cadmium bath as a result of churning of the solution in passing through the filter and pump. Cathode rod movement and the addition of a small amount of wetting agent should be helpful. It is also essential that highest cathode effiiciency, and hence a minimum of gassing on the surface of the parts, be maintained in the cadmium bath. The Cadmium Metal-Total Cyanide ratio is the most important factor in keeping the cathode efficiency high. Filtering the bath should not be an advantage in this particular case, and as explained above, may even be detrimental.

Quadruple Silver Plate

Question: We would like to know just exactly what steps are followed in getting a quadruple silver plate. We want to know how many times an article is put in the plating solution, how much time is allowed for each plating period, voltage used, etc..

B. A. W.

Answer: The term "quadruple plate" is one which is often mis-interpreted by the plating trade. Strictly speaking, the term relates to the actual *thickness* (or weight) of silver deposited on the parts. Many platers think, however, that it refers to the number of separate plating stages used in completing the silver plating of a part, regardless of the final thickness produced. This latter interpretation came about as a result of the common practice of removing the object from the plating bath after about a half-hour's plating, scratch brushing the surface to make it smooth, returning it to the plating tank, and repeating this sequence several times. Thus, three cycles in the plating tank gave a "triple plate," and four trips gave a "quadruple plate." The thickness was a matter of some question.

The reason for the scratch brushing was to remove any roughness and loose deposits, so that the final plate could be more easily buffed to a high luster without removing too much of the silver already deposited. With today's silver baths and plating techniques, it is possible to build up very heavy deposits without any roughness, so that the intermediate scratch brushing is not necessary. Filtered baths and periodic reverse plating are two of the important techniques that make this smooth plating possible in heavy deposits.

The thickness for "quadruple plate" on silver flatware is usually given in terms of total weight of silver per gross of parts. For instance, for teaspoons "quadruple plate" is a coating of 250 grams (8 troy oz.) per gross of spoons. Other items of flatware are plated with weights of silver in the same ratio as their surface areas. Dessert forks, for instance, would require 12 troy oz. per gross; table spoons, dinner forks would require 16 troy oz. gross. It is difficult to give the exact equivalent of this weight of silver in terms of actual thickness, as it varies somewhat according to the design of the particular piece. However, a coating of 8 troy oz./gross of silver on the average teaspoon, if the plating is evenly distributed over the total area, would give a thickness of .00136".

Holloware is treated differently. A "quadruple plate" on holloware requires 8 pennyweights of silver per *square foot*. This is equivalent to .0005". "Triple plate" is 6 dwt/sq. ft., and "double plate" is 4 dwt/sq. ft..

Plating Steel Racks to Prevent Contamination

Question: We have been advised that a nickel plate applied from a Watts bath on steel or iron plating jigs used for chrome plating would result in freedom from contamination of the chrome solution with iron or nickel. Can you give us any information on this? We have also heard that a copper-lead alloy plating jig would give freedom from incrustation and build up that usually occurs on regular antimony-lead or tin-lead jigs. We would appreciate your remarks on this also.

P. S. E.

Answer: Nickel plating a steel jig would result in less contamination by iron in the chrome solution, but there is no reason why a Watts nickel deposit should be any better than any other type of nickel deposit. There should be no problem with contamination by nickel, as witnessed by the fact that many full-automatic plating cycles

operate successfully over long periods of time by re-cycling poorly coated racks, having nickel build-up on them, through the chrome baths. However, the best method to use to prevent contamination is to coat the racks with one of the excellent coating materials now available. These resist attack by all the common solutions used in plating cycles and thus prevent waste of metal by build-up.

In regard to using alloys of lead-copper for chrome plating jigs, here again a suitable rack coating material is the best to prevent attack and chrome build-up. If these alloys are used as anodes there will certainly be undesirable copper contamination in the chrome solution.

Removing Fingerprints from Cadmium Plating

Question: We should like some information on the removal of fingerprints from cadmium plated parts. The process must not involve a dip treatment, as the parts involved are wired electronic assemblies which cannot become wet.

C. A. K.

Answer: A number of firms market fingerprint neutralizers and removers that can be soaked into a cloth for wiping the soiled areas. Names of these firms are being sent to you. A better suggestion is to use some sort of treatment of the cadmium plating immediately after plating and before any handling of the parts. A number of proprietary processes that prevent finger staining of the cadmium are available for this work. For certain soldering operations such chromate films may present problems, but these can usually be overcome by altering the soldering technique somewhat.

Tarnish Removal from Silver

Question: We are faced with the problem of removing light tarnish from very small silver plated parts, and wonder if you can suggest the best method for doing this.

S. G.

Answer: Assuming that the tarnish removal should be accompanied with some polishing or brightening action to restore luster to the parts, we would suggest that the parts be tumbled in soft leather scraps, or some similar mildly abrasive tumbling material. Steel balls with soap would also seem like a suitable medium for tumbling such parts, or it is possible that they may be self-tumbling, in which case a small amount of neutral burnishing soap is the only material required.

Plating Aluminum on Steel

Question: We are interested in the possibilities of plating aluminum on steel for a decorative finish. Can you supply any details of the processes involved?

F. R. H.

Answer: There is no practical method yet developed for plating aluminum from an electrolyte. Some organic solutions have been tried in the past, but these have not proved practical. Aluminum coatings can be produced by methods such as spraying and cementation, or electrolysis from fused salt baths at high temperatures.

Electropolishing Zinc Die-Castings

Question: We are interested in the electropolishing of zinc base die-castings, and would be grateful for any information you may have on this subject, and on the electropolishing of cast brass.

M. M.

Answer: Methods for electropolishing of die castings have not proven very practical, nor have methods for electropolishing cast brass. Both of these materials offer a duplex metallurgical structure, which is very difficult to electropolish successfully. The rates of solution of the various metallurgical phases on the surface of the parts is so different in the usual electropolishing baths that it is not possible to get good polishing results. If the cast brass is of a suitable composition, it might be able to heat treat it to bring out a homogenious metallurgical structure, in which case the electropolishing baths for wrought brass alloys might work satisfactorily. This is not possible with zinc die-castings.

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PATENTS

Plating Rack Design

U. S. Patent 2,512,554. *M. S. Schneider.*

A rack for supporting articles in an electroplating or like bath having a bus bar common to a plurality of racks comprising in combination an elongated metallic body including a portion for supporting the rack with respect to the bus bar, said body having an electrically non-conducting coating thereon coextensive with at least that portion of the rack normally immersed in the bath, a plurality of members detachably secured to the body, each said member including a U-shaped yoke embracing the body at a selected location thereon and having a threaded aperture in at least one of the legs of said yoke, an article-supporting arm carried by said yoke and having a threaded portion in engagement with said aperture, said threaded portion terminating at its free end in a point puncturing said coating thereby securing said yoke to said body and providing an electrical path from said body to said arm.

Abrasion-Resistant Finish for Magnesium

U. S. Patent 2,512,563. *H. K. De Long, assignor to The Dow Chemical Co.*

The method of producing an abrasion resistant coating upon an uncoated article of magnesium and its alloys containing at least 80 per cent of magnesium which comprises anodically electrolyzing the article in an aqueous solution the dissolved constituents of which consist essentially of an alkali metal borate in amount between 80 grams per liter and that producing saturation, an alkali metal silicate in amount between 5 and 100 grams per liter, and from 1 to 50 grams per liter of a water-soluble organic compound selected from the group consisting of methyl alcohol, ethyl alcohol, ethylene glycol, diethylene glycol, mannitol, phenol, sodium phenate, the pH of the solution being between about 10 and 12 and the electrolyzing potential being raised gradually from an initial value of between 0 and about 35 volts so as to produce a current density between about 5 and 40 amperes per square foot of surface of the article during the electrolysis and discontinuing the electrolysis when the applied voltage reaches a value between 80 and 150.

Purifying Alkaline Tin Baths

U. S. Patent 2,512,719. *R. O. Hull, assignor to E. I. du Pont de Nemours & Co.*

In a process for treating an aqueous, stannous plating bath of a pH from about 2 to 5, the step comprising treating the bath with a slight excess over that required to precipitate copper and iron of a compound selected from the group consisting of alkali ferricyanides and ferrocyanides.

Alternating Current Anodizing of Magnesium

U. S. Patent 2,513,237. *H. M. Freud dit Jean Frasch.*

A process of protecting magnesium-base metal objects in an electrolyte which consists essentially of an aqueous solution which is the liquid reaction product made by dissolving at least one substance selected from the group consisting of manganese carbonate, manganese dioxide and manganese oxalate, which substance contains from about 2.4 to about 3.4 parts by weight of the element manganese, in an aqueous solution of chromic acid alone, containing the equivalent of 10 parts by weight of chromic anhydride in about 100 to 1,000 parts by weight of water, the applying said liquid reaction product, while the latter is free from more than traces of acids which are capable of chemically attacking metallic magnesium and dissolving same, and free from more than traces of salts of such acids, and while such solution has a pH value between about 2 and about 5, as an electrolytic bath, in which is placed a pair of electrodes, at least one of which is such a magnesium-base metal object and the other electrode being formed of an electrically conductive material which is insoluble in said electrolyte, and applying to such electrodes an alternating electric current of between 1.5 and 12 amperes per square decimeter of surface of said magnesium-base metal object being treated, at a voltage between 4 and 40 volts, at about atmospheric temperature, and continuing the treatment until a good protective film substantially free of magnesium compounds has been formed on said magnesium object.

Bright Nickel Plating Bath

U. S. Patent 2,513,280. *H. Brown, assignor to The Udylite Corp.*

A bath for electrodepositing bright nickel comprising an aqueous acid solution comprising essentially a material selected from the group consisting of nickel chloride, nickel sulfate, a mixture of nickel sulfate and nickel chloride, a mixture of nickel sulfamate and nickel chloride, a mixture of nickel fluoborate and nickel chloride, a mixture of nickel fluoborate and nickel sulfate, a mixture of nickel sulfate, nickel chloride, and nickel fluoborate, and a mixture of nickel fluoborate and nickel sulfamate, said solution also containing an organic pyrazole compound soluble in the solution selected from the group consisting of N-alkyl (from one to six carbon atoms) pyridinium pyrazoles and quinolinium pyrazoles together with an aryl compound soluble in the bath and selected from the group consisting of benzene sulfonamides, benzene sulfonimides, benzene sulfonic acids, and naphthalene sulfonic acids, said organic pyrazole compound being dissolved in the solution in a concentration falling within range of from .001 gram per liter to .02 gram per liter of solution and said aryl compound being dissolved in said solution in a concentration falling within a range of from .02 gram per liter of solution to saturation.

Antimony Plating With Superimposed Alternating Current

U. S. Patent 2,515,192. *A. E. Chester, assignor to Poor & Company.*

In a method of controlling the electrodeposition of antimony from an antimony trichloride plating bath onto an electrically conducting object of a type in which the antimony would normally be deposited in greater concentrations in some areas than in others by a direct plating current: the step which comprises electrodepositing the antimony from an antimony trichloride plating bath by subjecting said object as a cathode in the plating bath to a plating current having an asymmetric alternating wave form comprising an alternating current superimposed on a direct current in the ratio of 2-4 volts R.M.S. to 2.5 volts D.C., regardless of the specific current val-

ues, at current densities from about 2 to about 15 amperes per square foot.

Blackening and Case Hardening Stainless Steel

U. S. Patent 2,513,302. *A. L. Feild, assignor to Armco Steel Corp.*

A corrosion-resistant case-hardened stainless steel product consisting of a nitrided case-hardened stainless steel portion having a chromium content of about 10% to 35%, and an overlying thin adeherent black metal oxide surface film portion of corrosion resistance substantially greater than said nitrided case-hardened stainless steel portion and integrally formed with the nitrided case-hardened stainless steel surface by treatment in a fused salt bath essentially consisting of at least one of the group consisting of sodium dichromate and potassium dichromate.

Organic Solvent Phosphating Bath

U. S. Patent 2,515,934. *H. G. Verner and L. S. Wood, assignor to Du-Lite Chemical Corp.*

A phosphatizing liquid for phosphate coating articles made of metal of the class capable of reacting with phosphoric acid to form a metal phosphate, consisting essentially of from one to seven per cent of concentrated phosphoric acids dissolved in an organic solvent therefor, said organic solvent being capable of being evaporated at a moderate temperature, and said phosphatizing liquid having no aqueous phase and containing only a small proportion of water based on its phosphoric acid content.

Phosphating Bath

U. S. Patent 2,516,008. *J. C. Lum, assignor to Westinghouse Electric Corp.*

In the process of applying phosphate coatings on metals, wherein simultaneous cleaning and activating of the surfaces of metals from the group consisting of iron, zinc, cadmium, aluminum and alloys in which these metals predominate is effected to enhance the subsequent formation of protective phosphate coatings thereon, the step comprising applying to the metal surface a hot acqueous solution consisting of (*a*) between 0.1% and 10% by weight of the dried residue of an activating composition derived by dissolving in water from 0.005% to 20% by weight of a water soluble compound of at least one of the group of metals consisting of titanium, zirconium, lead and tin and the balance being disodium orthophosphate, and evaporating the solution so produced to dryness, (*b*) from 2% to 50%, based on the weight of the dried residue, of a water soluble organic acid having a carboxyl radical attached directly to an aliphatic group to stabilize the activating composition, (*c*) an alkaline composition selected from the group consisting of alkaline alkali metal compounds, ammonia soaps and amine soaps suitable for cleaning metal surfaces, in an amount to provide a pH of from 10 to 12.5 in the acqueous composition, and the balance being water, the aqueous solution being at a temperature of between 160°F. and the boiling point, the organic acid enabling the activating composition to function at the high temperature for long periods of time.

Phosphate Bath for All Metals

U. S. Patent 2,514,941. *R. F. Drysdale and R. W. Parker, assignors to The Walterisation Co., Ltd.*

A liquid coating composition for the production of a protective coating on the surface of a metal selected from the group consisting of iron, steel, zinc, and aluminum, said liquid coating composition containing an aqueous solution of a metal phosphate and phosphoric acid and containing also in dissolved state a relatively small amount of anhydrous zinc ammonium phosphate.

Electropolishing Steel, Copper Alloys, and Aluminum

U. S. Patent 2,516,105. *E. der Mateosian.*

The method of electrolytically polishing metals of the group consisting of ferrous metals, nickel, brass and aluminum comprising making a specimen of the metal to be polished an anode in an electrolytic cell in which the electrolyte consists essentially of a mixture of a concentrated aqueous solution of an alkali metal salt of an acid selected from the group consisting of nitric, sulfuric, chromic, hydrochloric acids and a completely water miscible alcohol, adjusting the pH of the mixture to between about 6 and 8, chilling the anode to a temperature below that of the electrolyte, and passing an electric current through said cell.

Phosphating Bath

U. S. Patent 2,516,139. *J. Mazia, assignor to American Chemical Paint Co.*

In the art of treating ferriferous metal surfaces with a manganese phosphate coating bath, the method which consists in preparing an acid manganese phosphate bath containing the ions of a tartaric acid other than mesotartaric acid in quantity sufficient to substantially inhibit "sludging out" of metallic phosphate, and treating the surface with the bath to form the desired coating.

Hot Electrolytic Destruction of Waste Cyanides

U. S. Patent 2,520,703. *R. M. Wagner, assignor to General Motors Corp.*

The process of treating waste cyanide material which includes passing an electric current from an insoluble anode to a cathode through an aqueous solution of the waste cyanide material at a temperature of about 200°F. until the solution is substantially nontoxic.

Bright Nickel Plating

U. S. Patent 2,523,191. *H. Brown, assignor to The Udylite Corp.*

A bath for electrodepositing finegrained, lustrous nickel consisting essentially of an aqueous acid solution of a material selected from the group consisting of nickel chloride, nickel sulfate, a mixture of nickel sulfate and nickel chloride, a mixture of nickel fluorborate and nickel chloride, a mixture of nickel fluorborate and nickel sulfate, a mixture of nickel sulfate, nickel chloride and nickel fluoborate, said solution also having dissolved therein an unsaturated organic compound selected from the group consisting of allyl sulfonic acid

$$(CH_2{=}CH{-}CH_2SO_3H)$$

chlor allyl sulfonic acid and brom allyl sulfonic acid, said unsaturated organic compound having a concentration in the bath falling within a range of from about 1 gram per liter to saturation.

Engineering Information Useful in Designating Metallic Surface Treatments

Engineering Data Sheet

AREA CALCULATIONS FOR ROUND WIRE AND RODS

B&S Wire Gauge	Size in inches	Diam. in inches	Area Sq. Ft. per lineal Ft.	B&S Wire Gauge	Size in inches	Diam. in inches	Area Sq. Ft. per lineal Ft.
36		.005	.00131			.059	.01545
35		.0056	.00147		1/16	.062	.01623
		.006	.00157			.063	.01648
34		.0063	.00165	14		.064	.01676
33		.007	.00183			.067	.01754
32		.008	.00209			.071	.01859
31		.009	.00236	13		.072	.01885
30		.010	.00262			.075	.01964
29		.011	.00288			.080	.02094
		.012	.00314	12		.081	.02121
28		.0125	.00327			.085	.02225
		.013	.00340			.090	.02356
27		.014	.00367	11		.091	.02382
26	1/64	.016	.00419		3/32	.095	.02487
25		.018	.00471			.100	.02618
24		.020	.00524	10		.102	.02670
		.022	.00576			.106	.02775
23		.023	.00602			.112	.02932
		.024	.00628	9		.114	.02985
22		.025	.00655		1/8	.125	.03273
		.026	.00681	8		.128	.03351
21		.028	.00733	7		.144	.03770
		.029	.00759	6		.162	.04241
	1/32	.031	.00812	5		.182	.04765
20		.032	.00838		3/16	.187	.04896
		.033	.00864	4	13/64	.204	.05341
		.035	.00916	3		.229	.05995
19		.036	.00943		1/4	.250	.06545
		.037	.00969	2		.258	.06754
		.039	.01021	1		.289	.07566
18		.040	.01047		5/16	.312	.08168
		.041	.01073	0		.325	.08509
		.043	.01126	00		.365	.09556
17		.045	.01178		3/8	.375	.09820
	3/64	.047	.01230	000		.410	.10734
		.049	.01283		7/16	.437	.11440
16		.051	.01335	0000		.460	.12043
		.055	.01440		1/2	.500	.13090
15		.057	.01492				

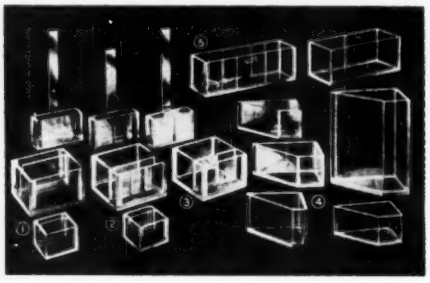
Recent Developments

New Methods, Materials and Equipment for the Metal Finishing Industries

Plating Range Cells

Singleton Co., Dept. MF, 9823 Lorain Ave., Cleveland 2, O.

A wide variety of standard and special plating range cells is available



from the above firm. These cells are used to check plating bath operational conditions, and provide information about the bath that is unobtainable in any other way. Impurity concentration, brighteners, wetting agents, correct current densities, are some of the conditions that can be rapidly and easily checked by these cells.

Cells are available in single slot, multiple slot, and special types, both complete cells or bottomless cells for immersion directly in the regular plating tank for making tests. Haring cells for testing throwing power are also included in this line.

Some of the wide range of designs are shown in the accompanying illustration. Further information may be obtained by writing to the above address.

Black Oxide Finish for Steel

Empire Solvents, Inc., Dept. MF, 153 East 26th St., New York 10, N. Y.

This firm announces an improved process for producing a black oxide finish for steel and iron, known as Empire Black. This process offers an extremely wide operating range of from 280°F.-300°F. and is accomplished with one bath. The process uses less salts to make up the bath and in turn may be maintained by smaller additions than are now common, it is claimed.

Two New, Low-Cost Iridites

Allied Research Products, Inc., Dept. MF, 4004-6 E. Monument St., Baltimore 5, Md.

This firm has announced the addition of two new types of chromate finishes to their line of Iridites for bright finishing of zinc plated surfaces. The new compounds are known, respectively, as Iridite No. 8P and Iridite No. 12.

Iridite No. 8P is a new departure in the field of chromate finishes. This new material is sold in powder form, as contrasted to most chromate compounds which are sold in liquid form. This factor alone provides the multiple advantages of: lower freight rates, easier handling and elimination of the use of carboys and their returns. Iridite No. 8P cost per gallon of working solution ranges from as low as 8¼c, when operating in the yellow color ranges, to about 35c per gallon when operating in the blue-bright ranges, according to the manufacturer.

The second new product, Iridite No. 12, is a chromate treatment for bright zinc plate that both passivates and imparts a chrome-like appearance to the plated surface. It is shipped in carboys in concentrated form. The concentrate is diluted with 50 parts of water to make a working solution. Unlike other Iridite bright-type finishes, Iridite No. 12 provides relatively little chemical polishing action for the zinc, thus it should be applied only to bright zinc deposits. However, operating costs for Iridite No. 12 are said to be extremely low, ranging to only 12c per gallon of working solution.

Like all Iridites, both new products are applied by a simple chemical dip method using standard finishing shop equipment.

Electrically-Conductive Casting Plastic

Atlas Mineral Products Co., Dept. MF, 42 Walnut St., Mertztown, Pa.

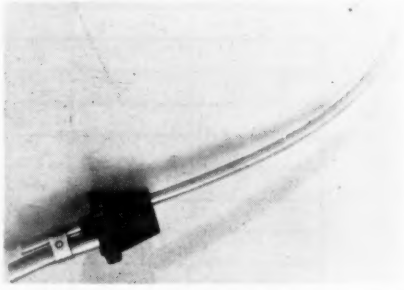
As a result of ten years of research in an attempt to develop a castable conductor of electrical current, this company has succeeded in producing a new and novel resin cement called *Conductoplast*, which may be cast in almost any form and exhibits practically no voltage drop when used as a conductor. Conductoplast can be readily plated, has a tensile strength of 1,500 p.s.i., a compression strength of 15,000 p.s.i., and excellent adhesion to ceramic materials, it is claimed.

As part of the development of *Conductoplast*, Atlas research chemists have also developed a non-conductor called Resistoplast. This product has much the same properties as Conductoplast except that it does not conduct current. Both materials are available in pilot plant quantities and production facilities can be expanded for critical end use.

Safety Air-Vent Carboy Pouring Spout

Hanson-Van Winkle-Munning Co., Dept. MF, Matawan, N. J.

Another widget supplied by this firm is a safety air-vent carboy pour-



ing spout, which insures an even flow of acid without spurts or splashes. It is made of acid-resistant rubber and plastic tubing built for long wear. All parts are replaceable and one size spout fits all carboys. These safety spouts are available from stock.

Tong Test Ammeters

Columbia Electric Mfg. Co., Dept. MF, 4519 Hamilton Ave., N. E. Cleveland 14, O.

The Tong Test is a unique instru-

ment inasmuch as it can be used to measure current in *both AC and DC* lines. Readings are taken easily and quickly by merely snapping the tongs

around the electrical conductor. It is not necessary to break the circuit or insulation. Voltage readings can be taken with the Voltor voltage attachment.

Rust Preventing Compounds

Gulf Oil Corporation, Dept. MF, 722 Gulf Bldg., Pittsburgh 30, Pa.

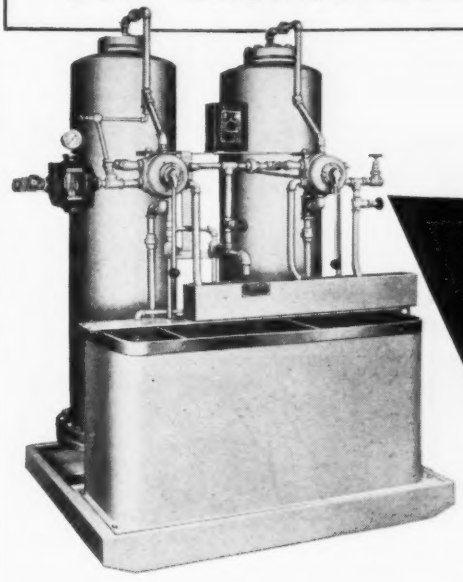
The new No-Rust No. 6 developed by the above firm is said to be good for protection of metal surfaces against corrosion in either indoor or outdoor exposure during domestic and overseas shipment, and for either indoor or outdoor storage for long periods of time.

Gulf No-Rust No. 6 is a rust preventive of the thin-film type and will provide approximate surface coverage of 390 square feet per gallon. It has no tendency to settle or separate in storage, and due to excellent adhesion the coating when once applied and dried will not crack, chip, scale or disintegrate at temperatures down to 0°F., nor will it flow at temperatures as high as 190°F., according to the manufacturer.

This new rust preventive will deposit a coating not exceeding 8 thousandths of an inch in thickness by dipping at a temperature of 70°F. and will dry

Eliminate Hot-Rinse Stains Unwanted Precipitates

USE CHEMICALLY PURE WATER



only a few cents a thousand gallons *with . . . .*

INDUSTRIAL Water Demineralizers

A Two-Bed INDUSTRIAL Water Demineralizer. Standard two- and four-bed units available with capacities of 200 to 1000 gph. Special units of any capacity engineered to requirements.

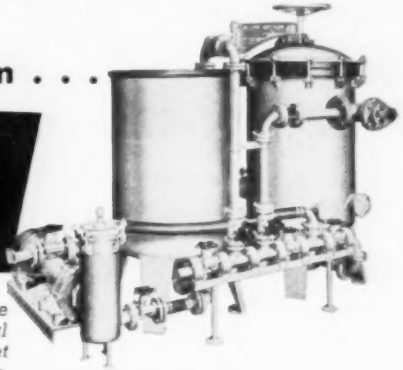
and it's as simple as it looks . . .

besides the extremely low cost, there is nothing complicated about getting the chemically pure water with Industrial Demineralizers. Raw water is passed through either two or four beds of ion-exchange resins and it comes out free of the dissolved mineral salts. No still, heat, steam, or cooling water is needed—keeping space requirements relatively small.

And it's simple to get the complete facts for your case. Send us a water analysis and let us know how much water you have to treat and the gallons per hour needed. We can then give you the whole demineralizer story including estimated costs, equipment required, performance data, etc. for your requirements.

for solution clarification . . .

use an **INDUSTRIAL Filter**



100 to 15,000 gallons per hour. Portable and stationary models. Standard or special filtration systems engineered to meet unusual requirements.

Write for full information and recommendations

FILTERS Pressure Type · PUMPS Centrifugal · CORROSION TESTING APPARATUS Salt Fog • Humidity

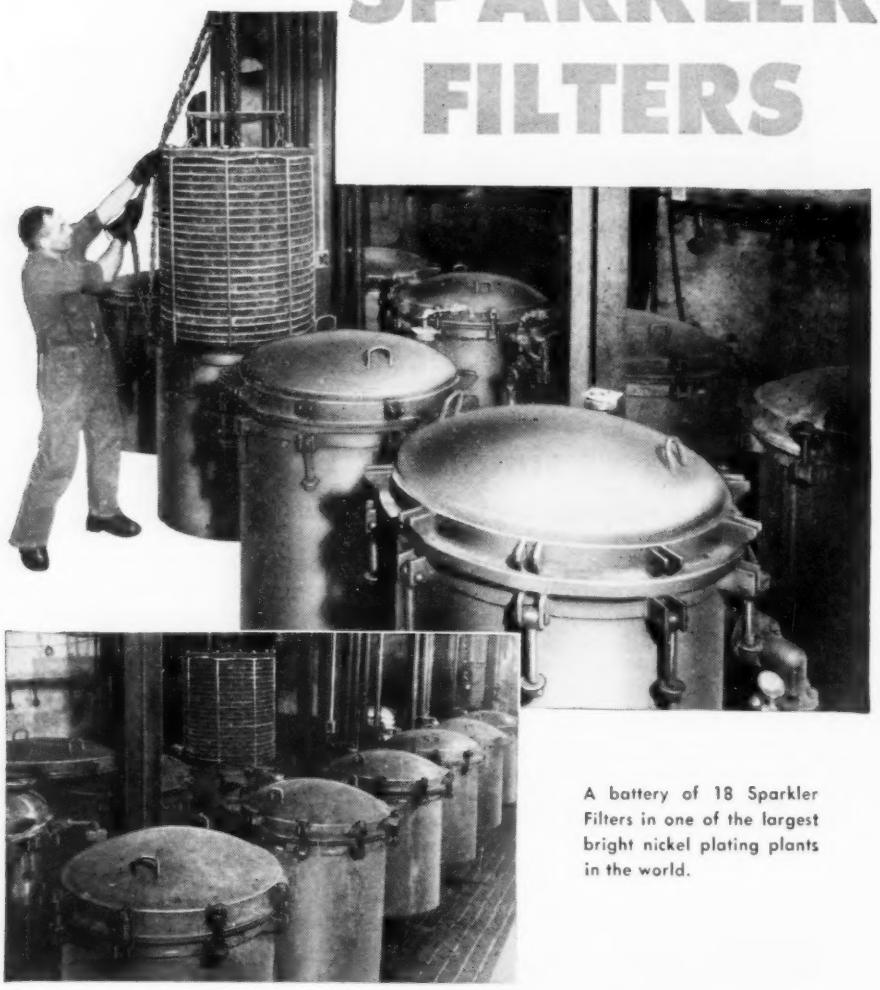
INDUSTRIAL FILTER & PUMP MFG. CO.

5906 Ogden Avenue
Chicago 50, Illinois

RUBBER DIVISION Vulcanized Linings • Molded Products · WATER DEMINERALIZERS

NO SHUT DOWN

To Carbon Treat Solution with SPARKLER FILTERS



A battery of 18 Sparkler Filters in one of the largest bright nickel plating plants in the world.

Carbon treatment without shut down is accomplished by cutting out one or two units in a battery of filters, removing the cartridge assembly of filter plates, and replacing with a new plate cartridge dressed with clean filter paper. The proper amount of carbon is mixed with water in a standby tank and recirculated through the filter thus depositing the carbon on the new plates in a cake of uniform thickness and density. The solution requiring a carbon treatment is then circulated through the carbon beds giving the plating solution the carbon treatment without contaminating the tank or stopping plating operations.

The quick change feature of the plate cartridge in Sparkler filters permits replacing a set of plates in a matter of minutes. Production can be resumed without appreciable interruption.

Sparkler Horizontal Plate Filters give absolutely sharp filtration at all stages of the cycle.

SPARKLER horizontal plate FILTERS

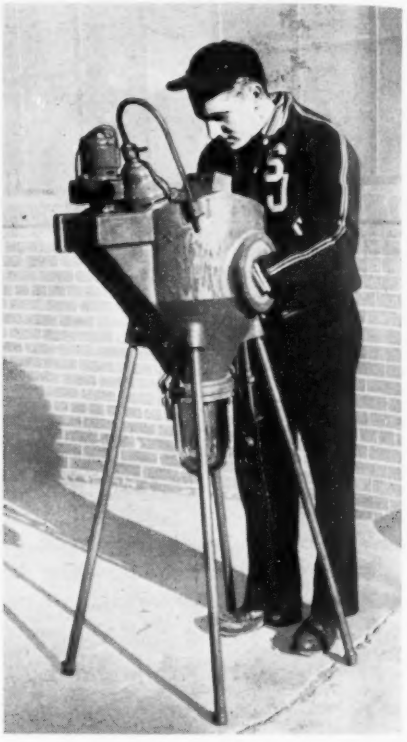
SPARKLER MANUFACTURING CO.
Mundelein, Illinois

sufficiently within four hours to permit handling without removal of the coating, it is claimed.

Gulf No-Rust No. 6 is suitable for application by brushing, spraying, or dipping and is readily removed with stoddard solvent, kerosene, or similar petroleum solvents.

Midget Unit for Liquid Blast Cleaning

Pangborn Corp., Dept. MF, Hagerstown, Md.



A new midget unit for liquid blast cleaning — only 40 pounds in weight (where aluminum can be used for the main housing), operable from either a 1/4-inch compressed air line or any bottle of compressed gas, and boasting a blast chamber 15 inches in diameter — offers the advantages of modern blasting methods to widely diversified groups. Further, it brings to makers and users of tools, dies, fixtures and molds (who may already be familiar with large liquid blast cleaning units) a small portable device for occasional work, small parts and experimental use. Heat treaters, electroplaters and builders of precision machinery will also find that the new baby unit fills a need for special work.

Called the Number O Type EZ Hydro-Finish Blast Cabinet, the new unit uses the same wide range of abrasives (as fine as 5,000 mesh) as its larger brothers, and can hold tolerances on

blast[illegible] parts to within 0.0001 of an inch[illegible] is claimed. It requires only 17" [illegible] 22½" of floor space; stands on easily adjusted legs of standard ½-inch pipe [illegible] can be bench mounted if desired[illegible]; requires only 110 volt AC to drive its filter and dust bag motor; consumes from 5 to 20 c.f.m. of air at [illegible] p.s.i. (depending upon nozzle size[illegible]; and is provided with a chamber light, right and left hand holes, a quick-opening valve for knee or leg operation, and an ample observation window protected from splash and dirt by a cross-current of fresh inlet air.

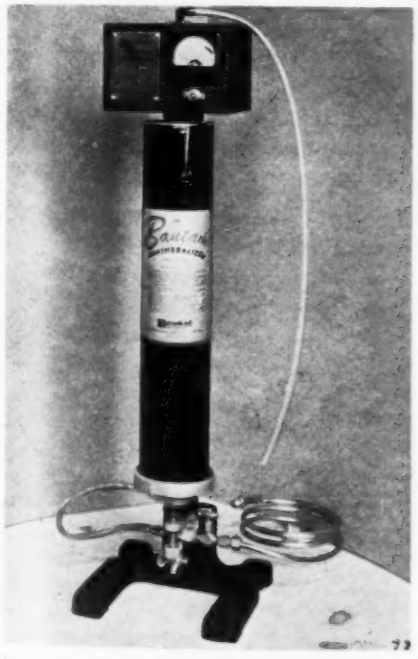
The abrasive-liquid mixture is slurried (and constantly bubbled) in a clear glass bowl of ½-gallon capacity at the base of the unit. Two sizes of suction-type blast nozzles may be had, the air-stream and abrasive-stream port sizes being 1/16-inch and ⅛-inch and ¼-inch, respectively.

Loading and part manipulation is easy and quick through a large top plate (containing the observation window) resting at a convenient angle atop the one-piece cast aluminum chamber.

Demineralizer with Direct Reading Meter

Barnstead Still and Sterilizer Co., Dept. MF, 2 Lanesville Terrace, Boston 31, Mass.

Barnstead engineers report that their



Bantam Demineralizer is now equipped with a direct reading meter which indicates water purity. This feature enables anyone to tell the purity of the water at any time and maintain a

ANNOUNCING
a radically new type of chromate finish for zinc and cadmium
IRIDITE #8P

1. NEW LOW MATERIAL COSTS!

Each gallon of working solution you mix costs from as little as 35¢ down to only 8¼¢, depending upon solution concentration and appearance desired. In addition, you get an extra 10% discount on material orders for 2000 pounds or more!

2. NEW LOW SHIPPING COSTS!

Iridite #8P is shipped to you as a *dry powder* in disposable steel pails. No liquids! No carboys! Saves up to 75% in freight; travels via low Third Class Rates. Pails take less storage space, reduce handling time and costs.

3. NEW BRIGHT OR GOLDEN FINISH!

A sparkling blue-bright finish results when you use Iridite #8P followed by a simple caustic soda bleach. Or, the coating can be produced as a golden-yellow iridescent film from a single dip by simply decreasing the concentration.

4. NEW ALL-PURPOSE USE!

New Iridite #8P can be applied by a simple chemical dip to any zinc or cadmium surface . . . plated, diecast, galvanized or sheet. Mixing is easy since the powder dissolves readily into solution. No special equipment or specially trained personnel is needed. Corrosion resistance is determined by the appearance desired; the choice is up to you. But for any appearance you are assured of maximum Iridite quality in corrosion resistant and paint base characteristics.

WRITE FOR FREE TEST SAMPLE or send samples of your product for finishing with new Iridite #8P. See for yourself how this amazing new Iridite treatment can cut your finishing costs.

Iridite is approved under government specifications.

ALLIED RESEARCH PRODUCTS
INCORPORATED
4004-06 E. MONUMENT STREET • BALTIMORE 5, MD.

REPRESENTATIVES IN PRINCIPAL INDUSTRIAL CITIES; West Coast: L. H. BUTCHER CO.
Manufacturers of Iridite Finishes
For Corrosion Resistance and Paint Systems on Non-Ferrous Metals and Ferrous Chromium.

Steel Parts Finishing, a vital requirement in defense production, must be handled with proven processes, methods, and materials. Don't take chances that may hamper production efforts.

DU-LITE Black Oxide STEEL FINISH has long demonstrated its superior qualities — its uniformity — its aid to lubrication when applied to engine bearings. Furthermore it is economical, and backed by Du-Lite's guarantee of results.

Leading manufacturers throughout the country, producing vehicle, aircraft, tank and marine engines, arms, bomb parts, instruments, tools, and machine parts, are using Du-Lite. If you want your product to measure up to the most rigid specifications use DU-LITE Black Oxide STEEL FINISH.

THE DU-LITE CHEMICAL CORPORATION

110 RIVER ROAD • MIDDLETOWN • CONN.

constant purity check on the flow of demineralized water. For convenience, the instrument is calibrated in parts per million and also in ohms electrical resistance.

As illustrated, the Bantam Demineralizer is also complete with a needle type regulating valve for easy flow adjustment, a drain valve and a sturdy base for bench mounting. Base may be removed if wall mounting is desired.

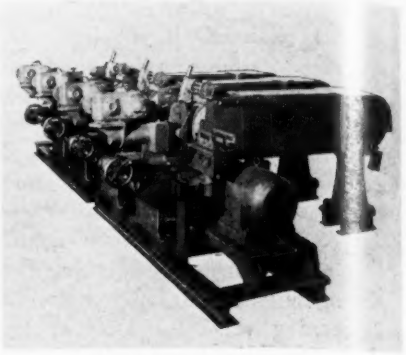
Users are said to report that these Barnstead Bantam demineralizers are ideal for hundreds of industrial operations and applications requiring relatively small amounts of demineralized water. Bulletins on Barnstead Bantam Demineralizers may be obtained from the above address, or from laboratory supply dealers who also stock the replacement high capacity cartridges.

High Speed Centerless Polishing Machine

Production Machine Co., Dept. MF, Greenfield, Mass.

In keeping with the current trend to faster speeds and increased production per labor dollar this company has developed a high speed centerless polishing machine.

Shown in public for the first time at the Chicago Metal Show, a tandem installation of these machines was demonstrated on welded steel tubing at 70 lineal feet per minute. Up to the present time such speeds for polishing cylindrical work was considered fantastic and yet these machines will produce nearly any desired finish if a



sufficient number of machines are used in the installation, it is claimed.

While maintaining the same general design as the standard speed machine, this high speed model has a completely new work feeding unit and motorized variable speed feed drive assembly. Simple adjustments within easy reach of the operator permit a range of feeding speeds upward of 70 F.P.M., according to the manufacturer.

Long recognizing the advantage of wider abrasive belts and buffs, the changes in design included a larger wheel spindle with capacity for contact wheel or buffs up to 6 inches wide.

Because of the high speed of operation and the fact that most tube polishing operations require several passes, these machines are usually installed in tandems of from two to six units. The attached photograph illustrates a typical installation of four machines, the first three equipped with idler backstands and the fourth machine arranged to use a buff for final operation. Adjustable roller fixtures are provided to support the work as it automatically passes from one machine through to final buffing operation.

Bright Chrome Plating Directly Over Zinc or Cadmium

Wire Coating and Mfg. Co., Dept. MF, 395 E. 131 St., Cleveland, O.

Of major importance to the automotive and appliance manufacturing field is the announcement by the above firm of the filing of patent applications covering the electro-deposition of a bright decorative chrome plate over a zinc or cadmium plated base. This plating is applicable to such metal parts as zinc or magnesium base diecastings, aluminum, and steel parts.

It is anticipated that this processing of a zinc plated part to permit a chrome finish will permit a great saving in nickel and copper metals, metals which heretofore have been necessary to provide a base for decorative

chrom plating. It is further anticipated th this new development will find wides ad application in the expanding w effort where protective finishes are r ired.

Pr ction lines are now being set up t permit sizeable quantities of materials to be available by March 1, 1951.

The *Wire Coating and Mfg. Co.* is a concern engaged in the manufacture of chemicals, additives, and brighteners for the electroplating field. Officers of the Company are *R. T. Hendrich*, President. *H. C. Vokoun*, Secretary-Treasurer.

Wax or Oil Dipping and Spinning Machine

Tinnerman Products, Inc., Dept. MF, Cleveland, O.

Efficiency in the oiling or waxing of small steel parts is increased three to four times in an automatically-operated spinning cabinet at Tinnerman Products, Inc., of Cleveland, manufacturers of the Speed-Nut type of fasteners.

The cabinet, designed and installed by Tinnerman engineers, also eliminates the necessity of workmen lifting and lowering baskets of fasteners weighing approximately 90 pounds from floor level to and from a height of approximately four feet.

The basket filled with parts is placed, at floor level, on a lift operated on a track in the front of the cabinet. The operator presses a button on the front of the cabinet, and the lift is raised by an electrically-operated hoist to the level of the front opening of the cabinet.

The operator then slides the basket into the cabinet and onto a metal disc.

A drum, operated by two air cylinders beneath it, and filled to a depth of 7 inches with oil or liquid wax, is then raised to permit the liquid to cover the metal parts.

After the fasteners have been submerged the drum is lowered until the bottom of the basket is above the surface of the liquid. The basket is spun on the disc at 450 r.p.m. for approximately 45 seconds. At the end of this interval a "dog" contacts the basket and stops its motion.

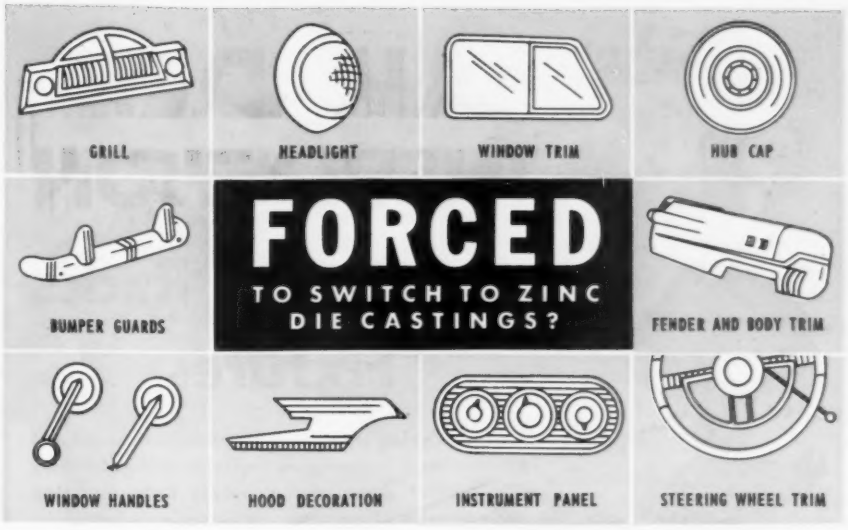
The drum is lowered further to clear the bottom of the basket. Another basket is slid into the cabinet, pushing the first one out onto a conveyor track which has been raised by a series of pulleys and a compensating weight, to the level of the opening on the side of the cabinet corresponding to the opening on the front.

The basket of finished parts then rides down the conveyor into a pivoted rack, where the parts are placed in a tray ready for further processing.

Hand Serrating Tool for Karbate Pipe

National Carbon Div., Union Carbide and Carbon Corp., Dept. MF, 30 East 42nd St., New York 17, N. Y.

This firm now has available an improved hand serrating tool for use with Karbate Brand Impervious Graphite pipe. Since Type FC Flexible Couplings are used in fitting impervious graphite pipe where strong, flexible joints are required, the effectiveness



Protect them with M & W Clear Coatings that stand 800 HOURS OF SALT SPRAY!

Zinc die castings and zinc plated steel are being used more and more as big manufacturers swing to these parts to replace unavailable materials. BUT the copper, nickel and chromium normally used for plating are in tight supply *too.*

Here's an effective way to meet this new problem. *Coat the die castings and zinc plated steel parts—instead of plating them!* Coat them with the M & W finishes that stand up under salt spray and weatherometer tests for the extraordinary period of 800 hours . . . that protect the zinc against discoloration!

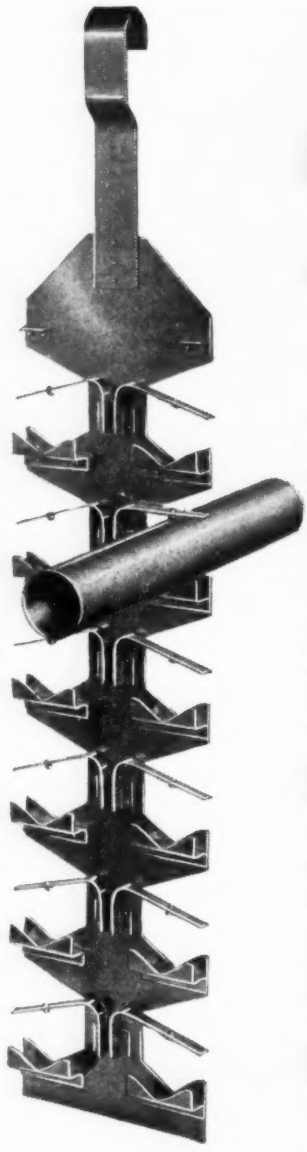
Use DULAC Clear Universal Lacquer #462 if you want an air-drying lacquer—CODUR Clear Synthetic Y743 for baking. They both give the same exceptional performance. Write for free Technical Data Bulletin #110, or let our M & W technical consultants discuss your requirements with you.

PIONEERS IN PROTECTION — 75th ANNIVERSARY — M & W CO. 1876

MAAS & WALDSTEIN COMPANY NEWARK 4, N. J. CHICAGO 12, ILL. LOS ANGELES 34, CAL.

PACIFIC COAST DIVISION: SMITH-DAVIS CO., 10751 VENICE BOULEVARD, LOS ANGELES 34, CAL.

MANUFACTURERS OF INDUSTRIAL FINISHES



AIR DRY INSULATION

Anodizing Racks Fixtures

New air drying insulation for aluminum racks and fixtures used in anodizing and chemical treatments will prevent destruction of costly racks and stop useless waste of current.

BUNATOL No. 796 is a high gloss black insulation of good body that can be applied by dipping, brushing or spraying. Formulated to resist acid solutions as used in anodizing operations. Excellent adhesion. Just a few coats provide a tough insulation that will resist abrasion and shop abuse. A low cost insulation operation which can be handled in any shop without use of an oven for baking.

STOP OFF A new quick air drying lacquer for use on aluminum to stop off anodizing. Dries fast and holds the edge. Just peel off to remove. A time and labor saver for selective anodizing.

Just a note on your letterhead will bring complete information on these interesting new BUNATOL products.

Nelson J. Quinn Company

TOLEDO 7, OHIO

of the joint depends to a considerable extent upon the quality of the serrations on the pipe.

The tool is simple, rugged in design and extremely easy to use, assuring a tight, workmanlike joint in a minimum of time, it is claimed. It provides an advantage over other types of piping since it facilitates quick assembly of "Karbate" pipe on the job site. Pipe sizes from 1" to 6" inclusive may be serrated.

Complete details of the hand serrating tool and the accepted method of serrating "Karbate" Brand Impervious Graphite pipe may be obtained by writing.

Small Handy Sandblast

The W. W. Sly Mfg. Co., Dept. MF, 4700 Train Ave., Cleveland 2, O.

This firm has just brought out a new handy sandblast cabinet for cleaning dies, tools, pistons, piston rings, valves and other small parts. This cabinet is shown in the accompanying illustration. It is complete, including two

light fixtures for illuminating the interior, an exhaust fan and a dust bag for making the operation dustless.

Its primary use is for cleaning small metal parts by the use of soft abrasives, such as ground corn cobs or ground nut shells. These will thoroughly remove all surface impurities without scoring the metal. It can also be used with sand or metal abrasives.

It has two rubber sleeves for both arms of the operator, with rubber gloves attached. It measures 14" x 17", and can be placed on a work bench, connecting it to a compressed air line and to a 110-volt lighting circuit for the lights and the exhaust fan.

Rubber Linings and Coatings

American Rubberizing Co., Dept. MF, 617 - 11th Ave., South Minneapolis, Minn.

Natural or synthetic protective coatings for metal or wood parts and products to provide protection against corrosion or abrasion is a service offered by the above firm. Equipment so bonded lasts longer, reduces plant shut-down, and decreases maintenance costs. All work is done at their Minneapolis plant.

Coatings, either dipped or sprayed, may be applied to any type equipment, inside and out, regardless of size, shape, use or quantity. Various applications include tank and chute lining, parts dipping, plating racks, screens, etc.

The illustration shows a 20′ x 4′ x 4′ steel tank to be used for nickel plating being made acid and corrosion resistant by spray application of neoprene laid on to a thickness of 3/16″ to 3/8″.

American Rubberizing also processes canvas and cotton knit gloves with natural rubber, Neoprene or plastic.

Stainless Steel Hose Clamps

Specialty Products Co., Dept. MF, 1965 East 66th St., Cleveland 3, O.

A new line of stainless steel hose clamps is announced by the above firm.

Already in mass production, these new S.S. Hose Clamps are available in six sizes ranging from ½ inch to 2 inches. The clamping band is made of 26 gauge ¼ hard stainless steel, while the "ears" are made of 18 gauge

stainless. According to the manufacturer, there is no possibility of corrosion since the complete unit, including the nut and bolt, is made of stainless steel. Specialty Products Co. makes six standard stainless clamps, and also engineers clamps to special requirements.

Operation
SMOOTH
"BREAK ALL CORNERS" is again required on machined parts for defense orders.
SIEFEN'S BRUSHING NUGLU will produce these specifications easily and quickly; PLUS simple cleaning of parts by water.
J. J. Siefen CO.
5643 LAUDERDALE · DETROIT 9, MICH.
Nationwide polishing and buffing service

Business Items

W. B. Phillips Made President of Pyrene

Wallace B. Phillips has been elected president of *Pyrene Manufacturing Company*, Newark, N. J., manufacturer of fire extinguishers, air foam playpipes and systems. He succeeds *Edward J. Waring*, who, upon his retirement in August, 1950, had served the Company for almost forty years as

W. B. Phillips

treasurer, vice-president and president.

Mr. Phillips has been a member of the Pyrene organization since 1913.

3M Co. Purchases 114 Acres in South Chicago

Recent purchase by *Minnesota Mining & Manufacturing Co.* of a 114 acre tract in southwest Chicago is part of a long range industrial development, *C. P. Pesek*, vice-president in charge of engineering, announced.

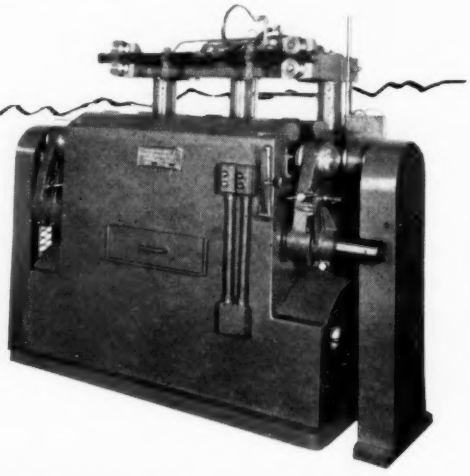
The tract is located on the west side of Harlem Ave. between 67th and 71st streets.

Pesek said a $3,000,000 plant now under construction for Mid-States Gummed Paper Co., a MMM subsidiary, is the initial project in the pro-

NEW Central POLISHING AND BUFFING MACHINE

Pays For Itself in 3 Months*

* A small manufacturer of novelties was faced with tremendous polishing costs. Central proved to him that two Model M4 Central Polishing Machines could cut his costs to a minimum and do a better polishing job at the same time. The machines paid for themselves in 3 months and the manufacturer now pockets the savings. If you polish flat or contoured surfaces in any quantity, it will pay you to investigate the possibilities of this machine. It costs nothing to inquire — ask for Bulletin.

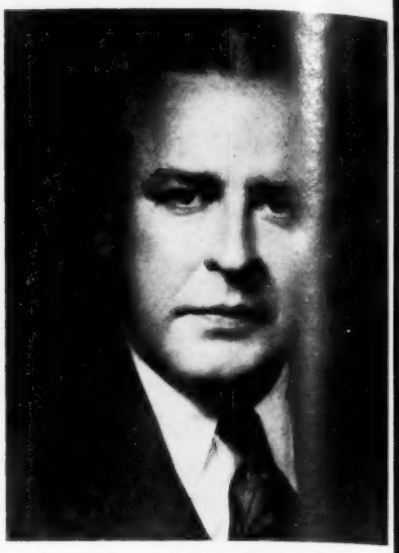


Central Model 4 Hydraulic Finishing Machine (18" stroke) is furnished with a contour attachment for polishing many contoured shapes as well as flat surfaces. Machine is well guarded for safe operation by unskilled operators. Model MM 1 (not shown) has a 36" stroke.

Central MACHINE WORKS

INCORPORATED 1918

75 COMMERCIAL STREET, WORCESTER, MASS.



L. L. Stouffer

gram. Work on the 265,000 square foot plant has been under way for several weeks.

Stine and Stouffer Elected Directors of Pangborn Corp.

Victor F. Stine and *Lloyd L. Stouffer* have been elected directors of the *Pangborn Corp.*, Hagerstown, Md. Pangborn manufactures blast cleaning and dust control equipment. Also, beginning Jan. 1, Mr. Stine assumes the duties of vice-president in charge of sales and engineering and Mr. Stouffer becomes secretary and treasurer and takes charge of production. Executive Vice-President *P. J. Potter* is retiring from his more active duties but will continue to serve Pangborn as director and vice-president. Mr. Potter will also act in a consulting capacity and will look after special assignments.

V. F. Stine

Mr. Stine, with Pangborn 38 years, started as a clerk, progressed through diversified activities and in 1935 became vice-president in charge of sales. His newly added vice-presidential responsibilities now embrace direction of engineering activities.

Mr. Stouffer, with the Corporation for 32 years, has served as secretary and assistant treasurer since 1940, in charge of accounting and procurement. He now becomes treasurer and takes charge of Pangborn's production operations.

Mr. Potter, having 35 years service, started in 1915 as Chicago district sales engineer and for the last 27 years has been located in Hagerstown, first as works manager and since 1935 as director and vice-president.

John C. Pangborn, director, first vice-president and treasurer of the corporation since its early founding, continues as a director and first vice-president and, together with Thomas W. Pangborn, will continue to administer the executive management of the Pangborn Corporation.

Detrex Contributes Engineering Specialist for National Emergency

W. I. Tebo has been appointed Washington Engineering Consultant and Technical Advisor for *Detrex Corp.*, Detroit 32, Mich., according to an announcement by *A. O. Thalacker*, Vice-President and General Manager.

To his new position Mr. Tebo brings vast experience in basic engineering research. During his 19 years of company service he has had

W. I. Tebo

laboratory, engineering and field experience in every phase of industrial metal cleaning. He is thoroughly familiar with Detrex facilities and potential for development, engineering, and production of defense materials.

Having recently returned from a special assignment in foreign countries, he will now make his headquarters at the Shoreham Hotel in Washington, D. C.

Empire Solvents Moves Plant to New Jersey

The plant of *Empire Solvents, Inc.*, manufacturers of Empire Black, an improved black oxide for steel, has moved to Clifton, N. J. Their general offices and laboratory are now located at 153 East 26th St., New York 10, N. Y. This company has representation in all principal cities.

Richard T. Barnes, Jr. Named West Coast Representative by Tumb-L-Matic, Inc.

Tumb-L-Matic, Inc., Bronx, N. Y., manufacturers of tumbling machines and processes, has just announced the appointment of *Richard T. "Dick" Barnes* as West Coast representative. Operating out of San Francisco, with a mail address of P.O. Box 227, Mr. Barnes will introduce Tumb-L-Matic equipment and processes to the entire West Coast.

Well known throughout the plastics and metals industry, Mr. Barnes was graduated from M.I.T. in 1930. After his graduation, he spent three years in the Plastics Div. of Monsanto Chemical Co., leaving that connection to join The International Nickel Co. With the exception of three years in the Navy, Mr. Barnes spent the years until he opened his San Francisco office with the same company, heading sales in the plastic, paper and heavy chemical industries.

R. T. Barnes

Baltimore-Washington Branch Presents Pot to President Neill

The Baltimore-Washington Branch made President *Wm. J. Neill* eligible for membership in the "Order of The Pot" by presenting a pot to him at the close of its January 9th meeting in Baltimore.

The presentation was made by Past President *Kenneth M. Huston*, a charter member of the Order of the Pot and its first Potscriber.

In his remarks prior to the presenta-

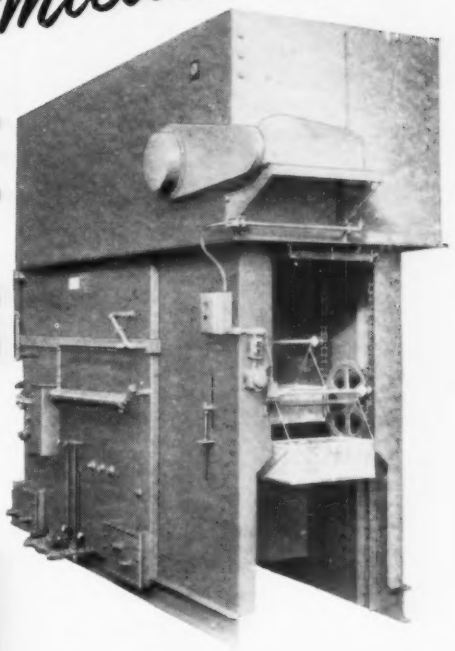
Economical

BLAKESLEE

SOLVENT VAPOR

DEGREASERS

USE LESS SOLVENT



BLACOSOLV

Stabilized Degreasing Solvent — one price, one solvent *for all metals*

NIAGARA

Metal Parts Washers for use with cleaning compounds on either batch or production jobs.

Blakeslee Solvent Vapor Degreasers USE LESS SOLVENT because of the patented construction and operational features. Metal parts are made chemically clean and dry in just a few seconds. Save time, labor, rejects with a Blakeslee Solvent Vapor Degreaser. A Blakeslee engineer-trained representative is available to solve your specific degreasing problems.

G. S. BLAKESLEE & CO.

1844 S. 52nd Avenue • Chicago 50, Illinois

New York, N. Y. Toronto, Ont.

NEW!

How to SAVE with Barrel Descaling ... Deburring ... Burnishing of Metal Parts

Many of the finishing operations on a wide variety of metals that are now being done by hand on individual pieces can be more efficiently handled in BULK in finishing barrels.

If you have not investigated barrel finishing methods for your products—it will pay you to write for this new bulletin. Its twelve pages are packed with useful information to help you either set up procedures for barrel descaling, deburring or burnishing, or to make improvements in your present barrel finishing operations.

Types of barrels, kinds of abrasives, suggested time cycles together with recommended Magnus Descaling Cleaner and Burnishing Compounds for most satisfactory results are fully covered.

Use the coupon below to ask for as many copies of BARREL FINISHING as your department can use.

MAGNUS CHEMICAL CO., INC., Garwood, N. J.

Send me _____ copies of BARREL FINISHING OF METAL PARTS.

Name _____ Title _____
PLEASE PRINT

Company _____

Street _____

City _____ Zone _____ State _____

National Officers of AES present when Bill Neill receives the Pot. Left to Right — Thos. F. Slattery, Past President and Honorary Member; Fred Fulforth, Kenneth Huston, Past Presidents; Wm. Neill, President; Wm. Blum, Honorary Member

tion, Huston explained the Order of The Pot was organized by Past President *Walter Pinner* after the Law Committee (consisting of Past Presidents) was deactivated by the new constitution.

The objects of the Order are:

1. To bind the Past Presidents of the Society into a group for the furtherance of the aims of the Society,

2. To promote good fellowship amongst those that have given the time necessary to operate the functions of the Society, and

3. To provide a group of experienced leaders to whom the Executive Board of the Society may refer problems of organization, policy or finance for counsel.

Membership is limited to those Past Presidents who have acquired a pot during their term of office as president.

Pots are acquired by (a) presentation by a Branch before whom he appears during his term of office, (b) talking his own Branch into presenting one to him or (c) stinkers preparing their own.

President Neill's pot was a hand formed brass bowl silver plated over copper, with a two inch copper stripe encircling the outside of the bowl. The president's name was engraved on this stripe. The inside of the bowl was gold plated and highly polished. A gold plated handle was riveted to the bowl with no-leakage rivets.

Annual dues in excess of a nominal operating fund are to be used to promote the welfare of the Society by stimulating articles for the Society's monthly publication, stimulating membership drives, or stimulating the Research Program.

The official slogan of the Order is "*At Least We Have A Pot.*"

Royal Clark Made Honorary Member of Newark Branch

Royal F. Clark, Sr., who has been a foreman electroplater for 50 consecutive years, and a member of the American Electroplaters' Society for 42 years, was on January 19, 1950 made an Honorary member of Newark Branch AES. Royal, as he was known among his AES friends, attended the preliminary meeting of foremen electroplaters on Saturday, March 6, 1909 at the Hotel Chelsea, 222 West 23rd St., N. Y. C., and was one of the 18 present who signified their intention of joining a society of electroplaters when formed. He also was Secretary of the National Electroplaters' Society of United States and Canada, as it was named when first formed. Secy-Treas. of Bridgeport Branch AES. Secy-Treas. of Newark Branch, and President of Newark Branch AES. He has written several articles on Electroplating which

were published in the "*Metal Industry*" in 1908, 1909, 1910, 1911 and 1916. During Royal's half century of electroplating he found time to become a stamp and coin collector and an amateur photographer. He is a member of the Vailsburg Newark Camera Club.

Geisinger New V.P. of Diamond Alkali Co.

Appointment of *A. L. Geisinger* to a vice-presidency in *Diamond Alkali Company* was announced today by President *Raymond F. Evans*, following action by the Board of Directors. In this new role with the company, which he long has served in executive capacities, Mr. Geisinger will have charge of Diamond's activity in the organic chemistry field.

At present Mr. Geisinger also is president of the *Martin Dennis Co.*, of Newark, N. J., one of Diamond's divisions.

Mr. Geisinger, born in Medina, O., was graduated from high school there. After receiving a degree in mechanical engineering from Ohio State U. in 1914, he began his lengthy industrial career in an engineering capacity with the Philadelphia Quartz Co., Philadelphia, Pa. In December, 1919, he joined Diamond Alkali at its Pittsburgh headquarters, launching a service record now exceeding 30 years.

During World War II he acted for five years as president of the Diakel Corp., another new venture. A joint wartime project of Diamond and the M. W. Kellogg Co., the Diakel Corp. operated a large fluid catalyst producing plant at Cincinnati.

In March, 1948, after Diamond expanded its position in the chromium chemicals field by purchasing the Martin Dennis Co. of Newark, N. J., Mr. Geisinger relinquished his 28-year duties as head of silicate operations to become president of this new division.

Mr. Geisinger is affiliated with the Masonic Order, the Elks Lodge, and Chartier's Country Club of Pittsburgh, Pa. He also is a member of the Chemists Club of New York.

Detroit Chemical Specialties In New Plant

Early in 1951, *Detroit Chemical Specialties, Inc.*, will move into its new and larger quarters at 101 S. Waterman St., Detroit, occupying a modern structure of approximately 26,000 square feet, it is announced by *Charles H. McAleer*, president.

CHROMIC ACID

99.75% PURE

MUTUAL CHEMICAL CO OF AMERICA — MUTUAL — NEW YORK N.Y. — SINCE 1845 — REG U.S. PAT. OFF.

SODIUM BICHROMATE
POTASSIUM BICHROMATE

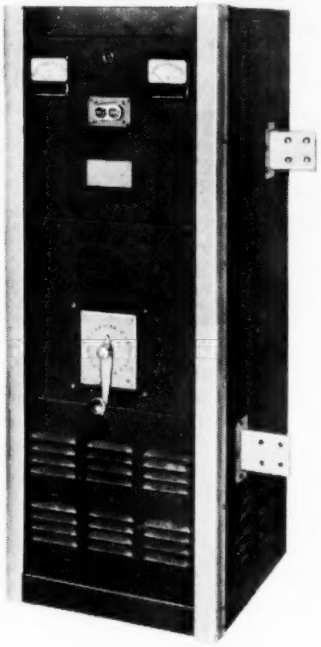
MUTUAL CHEMICAL COMPANY OF AMERICA

270 Madison Avenue, New York 16, N. Y.

The new plant acquired and remodeled by the company is equipped with the most modern steam-jacketed mixing kettles, extruding machines, and other equipment for manufacture of the products marketed by the company. Manufacturing standards are maintained by a well equipped chemical laboratory, and by a staff of experts with long experience in this field. The plant is served by an eight-car railroad siding, and also has excellent facilities for shipments by motor truck carriers.

Mr. McAleer is a veteran in the manufacture of rubbing compounds

All with the same Rapid Electric Rectifier



- CHROMIC ACID ANODIZING
- SULPHURIC ACID ANODIZING
- BARREL PLATING
- STILL TANK PLATING

Rapid Electric eliminates the need for specialized equipment to obtain the DC POWER necessary for your anodizing requirements. Rapid Electric, manufacturers of the finest in precision-built selenium rectifiers and controls, has converted that specialized equipment into standard utility rectifiers that will do your daily routine jobs.

Write now for FREE illustrated catalog and information.

NEW TESTING LABORATORY — Our completely modern testing facilities, capable of testing equipment up to 10,000 amperes, is now in operation. Every rectifier is put through exhaustive operating tests before leaving our plant to insure high quality, dependable performance.

RAPID ELECTRIC CO.

2881 Middletown Road • Bronx 61, New York

and polishes. He organized the McAleer Manufacturing Co. in 1923 and served as its president until 1941, when he disposed of his interests and the company was moved from Detroit to Rochester, Mich.

It was under his direction that the original rubbing compound or polish for lacquer finishes was developed.

After disposing of his interests in McAleer Manufacturing Co. in 1941, Mr. McAleer served for a period in the Army Air Forces, re-entering business again in 1946 when he organized the Detroit Chemical Specialties, Inc., to manufacture rubbing compounds, polishes and waxes.

The company also manufactures a complete line of platers' supplies and equipment for the industrial trade, as well as polishing and buffing compounds for the finishing of plated parts.

Electroplating Scholarships Given by Fulton Asphalt Co.

The *Joseph B. Kushner Electroplating School*, of Stroudsburg, Pa., takes pleasure in announcing that the *Fulton Asphalt Co.* of 165 W. Wacker Drive, Chicago, Ill., has made available to all persons who are interested in advancing in the field of electroplating, two scholarships in "Electroplating-Know-How," the home-study course in modern electroplating. Aware of the urgent need of the rapidly expanding plating industry for plating technicians who are trained not only to do plating but to *think* it, the Fulton Asphalt Co., by underwriting these scholarships, has become the first supplier in the history of the industry to promote such specific training for the betterment of the industry as a whole.

Fulton Asphalt scholarship winners receive a complete one year home-study training course in "Electroplating Know How," under the supervision of *Joseph B. Kushner*, well known electroplating engineer.

On completion of the course, a Certificate is awarded by the School, which is licensed by the Pa. Dept. of Public Education. This Certificate is recognized throughout the industry as the mark of a trained electroplating technician who can *think* plating as well as do it.

Any person who has the equivalent of at least a grammar school education can apply by following the simple scholarship competition rules listed below.

The following plating industry leaders will serve as judges of this competition: *Ezra Blount*, Editor of "Products Finishing"; *George B. Hogaboom*, Consultant; *Walter A. Raymond*, Editor of "Metal Finishing"; and *Gustav Soderberg*, Editor of "Plating."

Scholarship Contest Rules

1. At the top of a sheet of white 8½ x 11 paper, print your name, address, present occupation and company affiliation.

2. Fold over the top edge of the paper so that this data is not visible. Hold fold in place with a small piece of "Scotch Tape."

3. Starting above the center of the page, using ink or typewriting, complete the following statement, in fifty words or less:

"Electroplaters should be able to *think* plating as well do plating, because . . . ."

4. Submit this statement by mail to Electroplating Scholarship Contest, Box 230, Stroudsburg, Pa.

This Scholarship Contest is open effective immediately, and ends midnight May 20, 1951. Based on the decision of the judges named above, which will be final, the persons submitting the two best statements will be awarded the Fulton Asphalt Co. "Electroplating - Know - How" Scholarships.

Statements will be judged on the basis of sincerity, integrity and originality of thought. *Fancy rhetoric will*

not ... unt. Contest winners agree to abide by the School Regulations in accepting the Scholarships. All statements submitted become the property of the *Joseph B. Kushner Electroplating School*, and none will be returned.

The Scholarship Winners will be publicly announced as soon as feasible after the close of the contest. Those entrants who wish to be informed directly, in this connection, must enclose with their entry a self addressed and stamped return envelope.

Pennsalt Reports Record Earnings in 100th Year

The Pennsylvania Salt Mfg. Co.'s reported net earnings, after taxes, for the 12 months ended Dec. 31, 1950 were $4,005,862, the highest in the company's 100 years.

These earnings, subject to final audit, were 49 per cent higher than profits of $2,686,760 earned in 1949, and 118 per cent more than the average annual profit for the preceding decade.

Consolidated net sales for the 12 months ended Dec. 31 were $39,981,080, also the highest in Pennsalt's history. Sales for the previous year were $33,173,199.

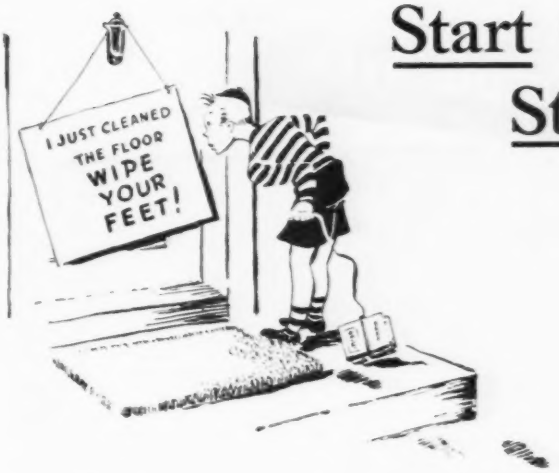
United Buff Builds New Plant in Jersey

United Buff Products Corp. has announced the completion of a new, modern, manufacturing plant at 233-241 Oak Street, Passaic, New Jersey. The full production capacity of this factory will be utilized in the manufacture of "Airflow" buffs and "Aircon" contact wheels.

The new plant is designed for straight line production, starting with raw materials at one end of the building and ending with shipment of the finished products at the other end.

Because of the increasing demand for pressure-cooled "Airflow" buffs and "Aircon" wheels, this additional capacity is most welcome at this time. These products are used extensively in the metal-finishing, plastics, lamp, automotive, silver and allied industries.

The company also announced that *Donald J. Wahler*, until recently Chief Engineer, has been appointed General Manager. Mr. Wahler attended Newark College of Engineering and was formerly associated with Simpro Corp. and Eisenmann Corp.



Start Clean... Stay Clean!

Mom's smart — and a good example for the plater. Actually, it's wasteful — and expensive — to prepare work for plating then put the clean metal into a bath of questionable purity!

Start clean . . . *stay* clean! Red Label Darco S-51 adsorbs in its pores the impurities that cause trouble in plating baths . . . takes them out of the bath before they can be deposited on the freshly cleaned surface of your work.

Red Label Darco helps you save on scarce anode metals . . . helps you do a better job with thinner deposits and minimize rejects.

With clean metal... keep the Bath Clean

Red Label Darco S-51 is especially treated for use in plating — the only carbon that meets the benzol-mercury test! It is especially easy to handle . . . easy to wet . . . easy to make into a slurry. Place your order for Red Label Darco S-51 today. Practically all suppliers carry Darco in stock, so don't accept substitutes.

DARCO DEPARTMENT
ATLAS POWDER COMPANY
Darco General Sales Offices
60 East 42nd Street, New York 17, N. Y.

OBITUARIES

ROBERT CROOKS STANLEY

Robert Crooks Stanley, Chairman of the Board of Directors of *The International Nickel Co. of Canada, Ltd.*, died on February 12 at his home at the Country Club Grounds, Dongan Hills, Staten Island, New York, at the age of 74.

Beginning in 1901, when he became associated with one of its predecessor companies, Mr. Stanley has provided the leadership through which International Nickel has emerged as one of the world's leading and most successful mining and metallurgical enterprises.

It was through his establishment of a Research and Development program in 1922 that the thousands of applications for nickel and its alloys were discovered and promoted. The fame of International Nickel Co.'s research is now world-wide.

Mr. Stanley was born in Little Falls, N. J., and was graduated from Stevens Institute of Technology as a Mechanical Engineer. He subsequently was the recipient of many honorary degrees. He was widely recognized in other fields as well, and was a Director in many large corporations, as well as an active worker in civic and scientific organizations.

He is survived by his widow, a son and daughter, and four grandchildren.

. . . Money-Saving Oven Installation at Estate Heatrola Division Noma Electric Corporation Hamilton, Ohio

This conveyorized, moisture removal oven dries two ground coats of frit on stove parts. The oven is direct gas-fired and automatically controlled.

From the unload end, the material passes immediately to spray booths where the second ground coat is applied. The material has retained enough heat from the drying of the first coat to immediately dry the second coat after spraying.

To conserve floor space, heating equipment is mounted on top of the unit, together with recirculating and exhaust fans.

Whatever your need in ovens, for drying, dehydrating or baking, consult KIRK & BLUM. Ask for booklet on "Industrial Ovens".

KIRK AND BLUM

INDUSTRIAL OVENS

The Kirk & Blum Mfg. Co.
2859 Spring Grove Ave.
Cincinnati 25, Ohio

YELLOTT F. HARDCASTLE

Yellott F. Hardcastle, a Director and ex-Vice-Pres. of *The Pennsylvania Salt Mfg. Co.*, died suddenly in Presbyterian Hospital, Philadelphia. He was 67 years old.

Mr. Hardcastle was graduated from Lehigh U. as an electro-metallurgical engineer in 1905 and then worked briefly as a smelting engineer in Mexico and the Southwest. In 1909 he joined the engineering department of Pennsalt's Wyandotte, Mich., plant and served as draftsman and supervisor of the electrolytic operations there until 1915, when he became superintendent. In 1928 he became Vice-President in charge of Manufacturing, a position he held until he retired in 1949. In 1932 he moved from Wyandotte to the company's executive offices in Philadelphia, and in 1948 was elected a company director, a position he held at the time of his death.

Well known as a hunter and fisherman in the Eastern Shore region for many years, Mr. Hardcastle had also pursued these sports in many parts of the eastern United States and Canada.

He is survived by a son, Yellott Fitzhugh Hardcastle, Jr., of Groton, Mass.; a daughter, Mrs. William P. Drake, of Berwyn, Pa.; two sisters, Mrs. P. K. Wright of Easton and Mrs. Charles E. Henderson, Jr., of Trappe, Md.; and seven grandchildren.

Manufacturers' Literature

De-Ionizing Equipment

Illinois Water Treatment Co., Dept. MF, 899 Cedar St., Rockford, Ill.

Water-conditioning equipment (Ion-Xchange) is described in an 8-page folder available from the above firm. Information covers ionXchange equipment including softeners, hydrogen zeolite, de-ionizers and the newly developed Illco-Way mixed-bed de-ionizer. Bulletin includes specifications on Illco-Way "package-type" units available for flow rates up to 1,000 gallons per hour.

Copper-Core Lead Anodes

Knapp Mills, Inc., Dept. MF, 23-15 Borden Ave., Long Island City, N. Y.

A folder just published by this firm discusses the problems inherent in chrome plating with lead anodes, then illustrates and describes the advantages of their line of copper-cored lead anodes. Because of the central copper conducting area, including the contact areas on the hook, these anodes are said to promote better current distribution and more uniform chrome deposits from conventional baths. These anodes are available in a wide range of sizes (18-48") and in specially shaped anodes for hard chrome plating. Copies of this folder are available on request to the above address.

Buffing and Polishing Compositions

Lasalco, Inc., Dept. MF, 2840 La-Salle St., St. Louis 4, Mo.

A new Lasalco catalog of "Buffing & Polishing Compositions" is just off the press and is available to plating and finishing shops or departments for the asking.

Containing a wealth of valuable information on buffing and polishing plastics and metals, the catalog is replete with charts showing compositions to use on all types of materials from aluminum to zinc, composition tests, characteristics of various kinds and grades of compositions, and much other useful data.

A copy of the new Lasalco "Buffing & Polishing Composition" catalog will be sent if requests are made on company letterhead.

Centerless Polishing Machines for Round Stock

Production Machine Co., Dept. MF, Greenfield, Mass.

A new catalogue issued by this firm illustrates and describes their wide line of automatic centerless-type polishing machines for polishing and buffing round stock and tubing. Types utilizing abrasive belts are available, and the machines are adaptable to tandem arrangement for high speed production. Auxiliary equipment is also described. Copies of this bulletin are available by writing to the above address.

Corrosion-Proof Linings

Atlas Mineral Products Co., Dept. MF, 42 Walnut St., Mertztown, Pa.

The above firm announces the publication of their new Corrosion-Proof Linings Bulletin No. 4-1. This bulletin describes Atlas' complete line of corrosion proof linings, including: sheet linings, solution or dispersion linings, brick sheathings and misc. linings. Write for your copy.

Pre-Tested Dust Collectors

Aget-Detroit Company, Dept. MF, Ann Arbor, Mich.

New 38-page catalog containing illustrations and specifications of the complete line of Dustkop Dust Collectors available in standard, pre-tested units is just issued by the above firm.

Illustrations are included of almost every typical dry grinding dust control problem; considerable space is also devoted to buffing and polishing dusts, as well as to the control of chips and shavings from both wood and metal working machines.

A cross index permits the reader to locate the recommended Dustkop, either by known c.f.m. capacity requirement or by the general classification of the dust involved.

Control of vapor and mist from various wet grinding and machining operations is also dealt with.

Accessories for installing, branch pipe, hose, hoods, blast gates, etc. — are also illustrated and priced.

Black Oxide for Steel

Empire Solvents, Inc., Dept. MF, 153 East 26th St., New York 10, N. Y.

This firm has just issued a new booklet describing their Empire Black process. The booklet covers the methods of applying the Empire Black Oxide finish for steel and iron and lists the advantages of this finish. Copies available free upon request on firm letterhead.

Tumb-L-Matic Barrel Finishing

Tumb-L-Matic, Inc., Dept. MF, 4510 Bullard Ave., New York 70, N. Y.

A new bulletin on the Tumb-L-Matic dry process has been released by the above firm. The bulletin describes the latest methods for cutting down, deburring, defining, dry burnishing and polishing metal and plastic parts. Tumb-L-Matic's Bulletin No. LS-50 describes the complete line of Type LS (single tumbler) equipment. Also included are descriptions of drives, sizes, controls and liners. Tumb-L-Matic's specific process is discussed to some extent. It consists of recommending the correct type of barrel and correct barrel speed, and the right compound or media. The compound can range in grades of abrasives and may be used with various rations of chips or pegs, depending upon product to be finished. Copies available on request.

Vinyl Drum Linings

Gates Engineering Co., Dept. MF, P.O. Box 1711, Wilmington, Del.

A data sheet issued by this firm explains their services in lining drums and supplying materials for the same purpose to be used in the plants of others. The finish can be applied by brush or spray. Coverage is said to

(Concluded on page 96)

For DEBURRING
Faster . . More Efficiently
More Economically!

Be Sure to Investigate...
the SPEEDIE Way!

THE KEYNOTE of today's defense program is *efficiency!* For an efficient deburring operation—whether on aluminum, brass or steel—you must have the *right compound* to remove burrs and heat scale as quickly and economically as possible!

SPEEDIE Deburring Compounds were developed for the defense effort. Tried and proven, they'll handle the toughest job faster . . . at lowest cost . . . and they'll save your wheels!

Tell us your deburring problems. We'll suggest the right SPEEDIE Deburring Compound that will do the job best! Write today.

Polishing Room Supplies and Equipment

BP THE BUCKEYE PRODUCTS CO.
7033 Vine Street Cincinnati 16, Ohio
Cable address: Buckprod

New Glass Fiber Tanks Ideal for Plating Solutions, Acids and Many Cleaners

Strong, Light, Economical PLA-TANK Excellent for Use with Luster-on ® Zinc Dips

Through the years many materials have been tried in the search for an ideal electroplater's or chemical processing tank. The latest of these is Fiberglas ®, impregnated and bonded with resins and molded into a seamless one-piece tank.

Sole sales rights on these new tanks for metal finishing, treating and chemical processing have been assigned to Chemical Corporation, 58 Waltham Avenue, Springfield, Mass.

According to the company's Metal Finishing Department, the new PLA-TANK (trademark under which it will be sold) is strong enough for a man to jump on, light enough to be handled easily, resistant to enough acids, plating solutions, emulsion cleaners and similar organic compounds to be highly versatile, inexpensive enough to be very competitive, and available enough to permit standard sizes to be delivered in under thirty days.

PLA-TANK Fiberglas tanks are suggested for most of those uses which have previously required stainless steel, plastic or rubber-lined tanks, acid-proof stoneware or crocks. In case of severe physical damage, the PLA-TANK may be quickly patched on the job in a matter of minutes.

Available without cost are general descriptive sheets on PLA-TANKS, list of current sizes and laboratory report on acids and other solutions tested as to corrosive attack.

Chemical Corporation suggests that its PLA-TANKS are specially well suited for holding its LUSTER-ON Bright Dip and newest LUSTER-ON Light Khaki Dip for use on zinc-plated work. These finishes have gained added significance from recent NPA bans on use of cadmium and nickel. Both LUSTER-ON Utility-15 and -25 Bright Dips are still being offered for 1951 on an allotment basis to new customers who wish to convert to zinc and Luster-on for their civilian goods.

Free data sheets will be sent to those requesting them and engineering consultation is available for conversions. Inquiries on PLA-TANKS or LUSTER-ON should be addressed to Chemical Corporation, 58 Waltham Avenue, Springfield, Mass.

(ADVERTISEMENT)

Concluded from page 95)

be 400 sq. ft. per mil of film thickness, with a normal film thickness of .004" recommended. Force drying at 250°F. is all that is required in the way of baking. The finish is said to combine flexibility and good adhesion, so that even if the drums are dropped the film will not part from the steel surface.

Copies of this bulletin are available from the above address.

Temperature and Pressure Instruments

H. O. Trerice Co., Dept. MF, 1420 W. Lafayette Blvd., Detroit 16, Mich.

A catalogue recently issued by the above firm illustrates and describes their line of thermometers, hydrometers, recording pressure gauges, diaphragm motor valves, temperature regulators, traps, and other instruments required in the control of temperature and pressure in various industries. Each of the above instruments is available in a wide range of types for special applications. Copies of this catalogue are available on request to the above address.

Fluid Flow Rate Testing

Fischer & Porter Co., Dept. MF, 3780 County Line Rd., Hatboro, Pa.

A Technical Report originally prepared for company staff engineers is now being offered free of charge. This report contains comprehensive data on the newest technical developments on fluid flow rate testing. A complete discussion of engineering principles as well as detailed flow curves and charts is included. In addition, this bulletin describes the newest calibration techniques and illustrates modern precision-accuracy calibration panels. Copies of Technical Report A-9C-4 may be obtained by writing.

Liquid Meters

Buffalo Meter Co., Dept. MF, 2917 Main St., Buffalo 14, N. Y.

Recently published by this firm is a new catalogue of all types of industrial meters for measuring water, oils, gasoline, chemicals, and many other liquids. Types are available for any pressure range for any temperature range, and including models for handling corrosive materials and chemical solutions. Copies of this catalogue may be obtained by writing to the above address.

Filter-Cleaner for Compressed Air Lines

Logan Engineering Co., Dept. MF, 4901 Lawrence Ave., Chicago 30, Ill.

A data sheet by this firm illustrates and describes the applications for its in-line filters and cleaners for compressed air lines. Centrifugal action is used in their Aridifier for insuring the delivery of clean, dry air. The firm claims that their items are easily installed and maintained. They are made for air line pressures up to 150 p.s.i., and will deliver up to 17,000 c.f.m. Copies of this data sheet to help in selecting the proper line Aridifier may be obtained from the above address.

Aluminized Steel

Armco Steel Corporation, Dept. MF, Middletown, O.

Aluminized Steel—steel with a special coating of aluminum—is discussed in a new booklet published by the above firm.

The illustrated 24-page booklet describes the steel's aluminum surface, its heat and corrosion resistance, and outstanding heat reflectivity—80% up to 900°F. Photographs and a listing of applications show where manufacturers have used aluminized in a wide variety of products.

Also included are data on mechanical and forming properties, available sizes and gages, as well as detailed recommendations for welding by various methods, brazing and finishing.

Dust Control Technology

Pangborn Corp., Dept. MF, Hagerstown, Md.

Detailed selection, operation, and maintenance data for the plant engineer responsible for dust control is contained in a 50-page, 5" x 7¼" digest-size book — "Industrial Dust Control Through Exhaust Systems" — offered by the above firm. Liberally illustrated with 15 photographs and 10 line drawings, the book treats, in three major sections, (1) Exhaust Hoods and Piping Systems, (2) Dust Collecting Equipment, and (3) Exhausters and Drives.

Introductory chapters list basic methods of accomplishing dust control; give reasons why improperly planned dust collection installations do not fully perform their function; tell why experienced engineering skill should be applied to the dust collection

problems and analyze with text and line drawings the three basic elements of dust control exhaust systems.

The chapter on Exhaust Hoods and Piping Systems discusses: (1) control of air movements, (2) recommended hood and enclosure design and arrangement, (3) exhaust air velocity and volume, and (4) rules for installing industrial exhaust system piping.

A 16-page illustrated section on Dust Collecting Equipment gives factors which influence its installation. Then follows descriptive and application information on the following types of dust collecting equipment: (1) settling chamber, (2) centrifugal collector, (3) baffle type collector, (4) fan type centrifugal separator, (5) wet or washer type collector, (6) electrical precipitator, and (7) cloth type filter. Included in this chapter are data on continuous and intermittent service, spark arresting, and collector hoppers.

The chapter on the Exhauster and Drive tells how to determine exhauster capacity by considering the total air volume to be handled and the total air flow resistance of the system. Components comprising the total air resistance are given. Types of exhausters, drive recommendations, and exhauster and motor foundation and housing requirements are discussed in this section.

A final 8-page chapter is devoted to exhaust system operation and maintenance. In this chapter are given methods of testing and evaluating exhaust system effectiveness; recommendations for locating indicating instruments desirable for making periodic check-ups; and 17 steps to follow when making routine inspections.

To make the book specifically helpful to the individual reader, a detached problem sheet is included on which the reader can enter data particular to his case. Compilation of this data expedites the work of the dust control engineer when working out system details.

Copies of "Industrial Dust Control Through Exhaust Systems" may be obtained free of charge from the above address.

Automatic Artificial Respiration

Mine Safety Appliances Co., Dept. MF, Braddock, Thomas and Meade Sts., Pittsburgh 8, Pa.

The M-S-A Pneolator, which now makes possible automatic artificial respiration without suction, is described in a new 4-page bulletin No. CH-2, published by the above firm.

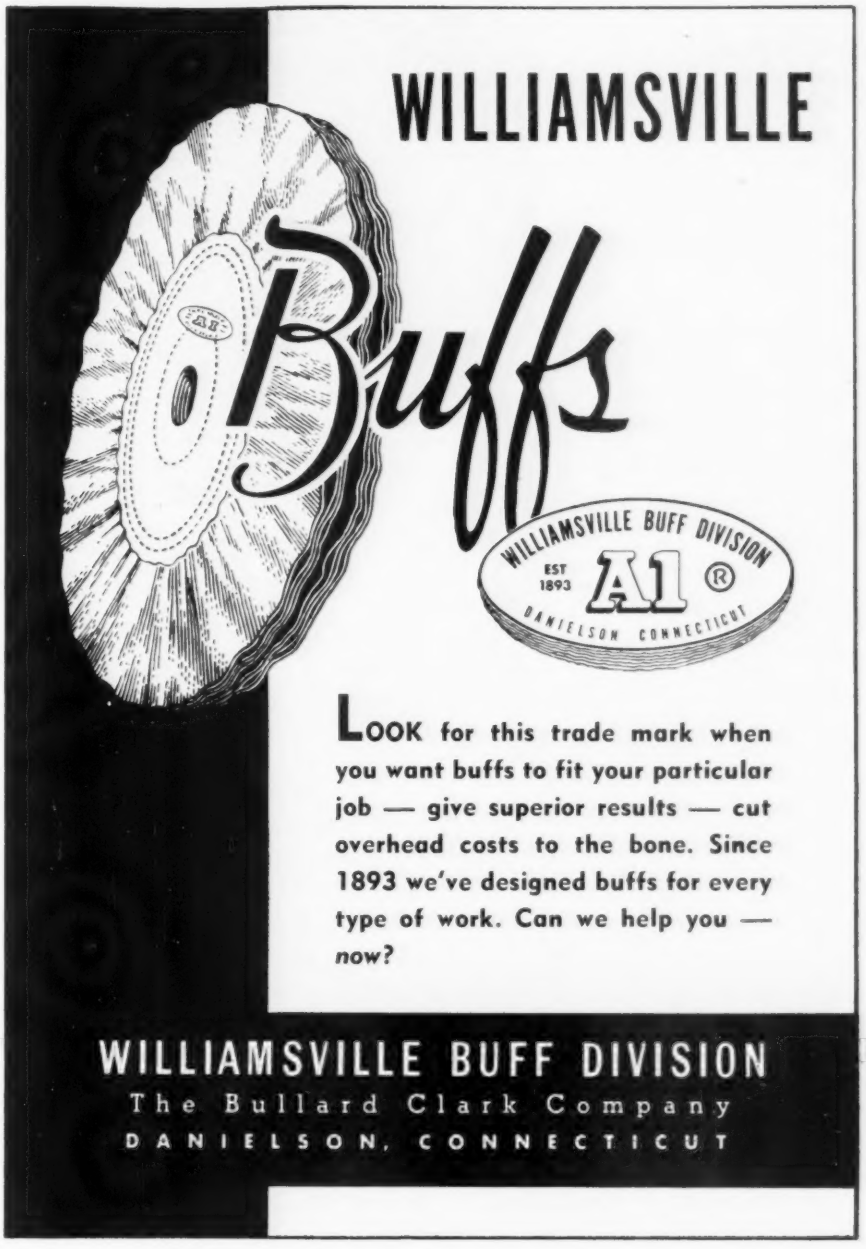
The recently introduced Pneolator uses intermittent positive pressure to provide safe, uniform lung ventilation in cases of respiratory failure. In operation, the M-S-A Pneolator automatically inflates the lungs with oxygen in the right amount and at the right pressure for the unconscious victim's physical requirements. No suction is employed, exhalation taking place by normal passive return of respiratory muscles in the lungs from the expanded state of inhalation. After voluntary breathing starts, the Pneolator serves as an inhalator to satisfy the patient's demand for oxygen. A second patient may be given simultaneous treatment by means of an auxiliary attachment with a separate control panel.

Compact, and weighing only approximately 47 pounds complete, the Pneolator is contained in a strong, yet light, Fiberglas carrying case. For a free copy of bulletin No. CM-2, write direct.

Corrosion Processes Measured by "Television"

Electrochemists at one of the country's largest industrial research centers have established another beachhead in their battle against the harmful affects of corrosion.

A new technique, designed to meas-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LOOK for this trade mark when you want buffs to fit your particular job — give superior results — cut overhead costs to the bone. Since 1893 we've designed buffs for every type of work. Can we help you — now?
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FOR
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USE
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THESE ***BUILT-IN*** FEATURES GIVE YOU LONGER LIFE AND MORE EFFICIENT OPERATION

- **HOMOGENEOUSLY ATTACHED HOOK** — Perfect metallic contact.
- **EXCELLENT CONDUCTIVITY** — Heavy center rib section.
- **RESISTS WARPING AND CURLING** — Angular cross-section for strength.
- **MAXIMUM THROWING POWER** — Multi-edge faces.
- **DENSE UNIFORM STRUCTURE** — Uniform corrosion.
- **CHOICE OF** (1) THICKNESS ½", 1", 1½", (2) ANY STANDARD ALLOY (3) HOOK SIZE AND STYLE

Optional... A Plastic Coating on the hook in addition to the standard lead coating. This plastic is resistant to chromic acid spray and drag-out. The cost of this extra feature is small, and the coating increases anode life, therefore further lowering production costs.

› Send your anode specifications to Heil for complete information.

Investigate HEIL Complete Manufacturing Service...Tanks, Linings, Tank Heating Units for ALL Metal Finishing Processes.

Heil PROCESS EQUIPMENT CORP.
12901 ELMWOOD AVE. • CLEVELAND 11, OHIO

ure the effects of corrosive solutions, may substantially reduce the nation's annual corrosion costs, estimated at $5.5 billion, or about $37 per person.

Developed at *Armour Research Foundation* of *Illinois Institute of Technology*, under the sponsorship of the National Advisory Committee for Aeronautics, the new method is similar to television scanning and can be used for detection, study, recording, and analysis of corrosion phenomena.

Dr. Howard T. Francis, supervisor of electrochemistry at the Foundation, explained that scientists can now measure corrosion as it takes place, regardless of the metal involved.

Corrosion, of which rust is an example, is caused by thousands of local cells similar to microscopic flashlight batteries. The electrochemical cells are formed by corrosive chemicals and the metal itself.

By studying the action of these tiny, unwanted electrical cells, electrochemists can learn more of the fundamental facts regarding corrosion.

"The laboratory sample on which corrosion occurs is a metal cylinder. This cylinder is dipped in some corrosive solution such as sea water, rotated several hundred times a minute, and scanned with a stationary probe electrode," Dr. Francis explained.

The probe electrode, which is a plastic arm containing 11 silver wires, is placed about .02" away from the submerged cylinder. It picks up the minute electrical currents caused by corrosion and enables scientists to measure and study the process.

"These tiny currents can be amplified and viewed on an oscilloscope screen or photographed for later analysis," Francis said.

One advantage of this method is that it permits easier and faster study of the entire surface area of a corrosion sample.

The new technique can be used for investigations of cathodic protection, corrosion inhibitors, stress corrosion, and in fundamental corrosion studies.

NEW BOOKS

Transactions of The Electrochemical Society — Volume 96 (1949)

Pub. by the Electrochemical Society, 235 W. 102 St., N. Y. 25, N. Y. 405 pages 6 x 9. Price to non-members $7.50.

Contains the report of the Annual (96th) General Meeting of the Society held in Chicago, along with the records of award winners and Division reports. Among the papers of interest to the field of electrodeposition are the following, with discussions:

The Rate of Solution of High Purity Aluminum in Various Bases —*M. E. Straumanis* and *N. Brakss.*

Attempts to Electrodeposit Tantalum— *H. J. Seim* and *M. L. Holt.*

The Electrodeposition of Molybdenum from Aqueous Solutions — *Sister Mary Joecile Ksycki* and *L. F. Yntema.*

The Dissolution of Aluminum in Sodium Hydroxide Solutions. II— *Michael A. Streicher.*

The Electrodeposition of Molybdeunm Alloys—*H. J. Seim* and *M. L. Holt.*

A High-Efficiency Anode for Alkaline Tin-Plating. The Effect of Alloying Constituents on the Anodic Behavior of Tin in Alkaline Stannate Solutions—*Frederick A. Lowenheim.*

The Effect of Oxygen on Inhibition of Corrosion by Nitrite—*Morris Cohen, Rowena Pyke* and *Paul Marier.*

Salt Bath Chromizing — *J. E. Campbell, V. D. Barth, R. F. Hoeckelman* and *B. W. Gonser.*

The Effect of Minor Alloying Ele-

men... on the Rate of Dissolution of Alu...num in Bases—*M. E. Straumanis* and *N. Brakss.*

The Vapor-Phase Deposition of Refractory Materials. I. General Conditions and Apparatus—*I. E. Campbell, C. F. Powell, D. H. Nowicki* and *B. W. Gonser.*

The Electrodeposition of Zinc on Zinc Starting Sheets—*Glen C. Ware, Henry E. Blake, Jr.* and *Kenneth B. Higbie.*

Experiments in Chromium Electrodeposition with Radioactive Chromium — *Fielding Ogburn* and *Abner Brenner.*

Symposium on the Rapid Identification of Metals

Pub. by the American Society for Testing Materials, 1916 Race St., Phila., 3, Pa. 78 pages, 6 x 9 paper bound. Price $1.25.

Contains the following articles;

Development, Present State, and Outlook for Spot Test Analysis—*F. Fiegl.*

Electro Spot Testing and Electrography—*H. W. Hermance* and *H. V. Wadlow.*

Instruments for Rapid Metal Identification—*R. R. Webster.*

Separating Alloys by Relative Spot Tests—*H. Kirtchik.*

Rapid Identification of Copper Alloys—*R. P. Nevers.*

Rapid Identification of Metal Finishes—*A. Lewis* and *Dr. R. Evans.*

Examination of Protective Coatings by Electrographic Analysis—*N. Galatzine* and *S. E. Q. Ashley.*

Field Test Kit and Procedure for Identification of Nickel Alloys and Stainless Steels—*H. B. Lea.*

Rapid Tests for Alloy Steels—*E. C. Kirkham.*

General Discussions.

Metal Cleaning Abstracts — 1950 Supplement

By Jay C. Harris. Pub. by Amer. Soc. for Testing Materials, 1916 Race St., Phila. 3, Pa. 27 pages, 6 x 9, paper bound. Price $1.00.

This volume supplements the original Metal Cleaning Abstracts, by *Jay C. Harris*, published in 1949. The present supplement contains additional references for 1932-1948, and new references for the years 1949 and 1950. All items are listed according to Subject Index, Author Index, Specification Index, and Patent Index. Eighty one references for the past two years are included, as well as 89 additional references for 1932-1948.

Ion Exchange Patent Group List

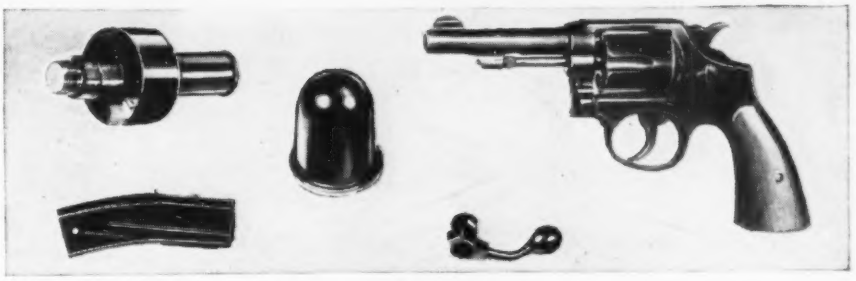
Pub. by Patent Publications, Dept. MF, P.O. Box No. 4094, Washington 15, D. C. Price $5.00.

The ion exchange process has been known for over a hundred years, and half of that time it has been utilized by American technologists. It is only within the past decade, however, that a high degree of efficiency has been developed for the process in large scale operations, made possible by the formulation of synthetic ion exchange resins specifically designed for the meeting of varying conditions in a large number of fields.

Realizing the current interest and importance of this subject, Patent Publications, Washington 15, D. C., have issued a new group-list of synthetic resin patents with miscellaneous applications in ion exchange processes. Containing 166 patents in all, of which the main technical claims are given, the patents date from 1934 through the year 1950. Exact expiration dates of all patents are shown. This is the first time a list of synthetic resin patents has been compiled according to

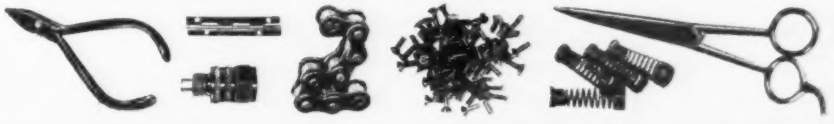
BLACK MAGIC

The PROVEN Finish For Military and Civilian Items



Black Magic is a lustrous, permanent black for steel and iron. It meets military specifications for this type of black oxide finish. Not only an attractive finish but also a good bond for paints and lacquers. The ideal substitute for commercial plating, especially now with present plating material shortages. For fully automatic or hand operated tanks. Write for our complete catalog.

Items for civilian use with BLACK MAGIC finish.



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Made from virgin metal
Not a trace of harmful impurities
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HANDY & HARMAN 999 "PLUS" FINE SILVER ANODES

When you see that triangle and "999+FINE" mark on a silver anode you can be sure of three things about that anode—(1) it is free of every trace of impurities that can cause plating troubles—(2) it measures up to highest standards in fineness—(3) it has physical properties that are ideal for plating . . . And when you *use* those anodes you can be sure of smooth going, profitable production of top quality plating. Next time you buy silver anodes, try the "999+FINE" brand and see the difference.

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the use of the product, and researchers in this field will welcome its availability and the fact it shows practically every patent in this category ever listed by the U. S. Patent Office.

Metallic and Non-Metallic Coatings for Gray Iron

By Charles O. Burgess, Technical Director, Gray Iron Founders Society, 210 National City— East 6th Bldg., Cleveland 14, O. Price $1.75.

Describes for the first time practical workable methods of applying all known types of coatings to gray iron castings. Suggestions include means of improving appearance and obtaining wider consumer acceptance of products. Written in plain language, this handy reference manual also contains 45 graphic illustrations of coated castings—a very complete bibliography on each coating process—and a representative list of manufacturers experienced in coating application.

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Coloring

Cement Linings and Armor

Picture Credits

Bibliography

News from California

By Fred A. Herr

Ownership of the *Spence Electroplating Co.*, Los Angeles, has been acquired by *Walter Behlendorf* and *Milton Crompton*, who are operating it as a partnership.

Behlendorf and Crompton directed the affairs of the plant for quite some time prior to the death, last October 26, of *Clarence G. Spence*. Mr. Spence had been in semi-retirement and had left the operation of the plant largely in the capable hands of his two associates.

Walter and Milton plan to continue to operate the shop for handling a general line of protective coatings and decorative plating. Their specialty will be plating of aluminum and zinc die-castings, in which field Crompton has

been a recognized specialist for some 20 years.

They will also do a complete line of anodizing and Alumiliting under license from the Aluminum Company of America. The Spence shop did a heavy volume of aircraft work during the war and is prepared to reconvert to that type of work again, if conditions demand it, Behlendorf declared.

Down in Long Beach, Calif., *E. G. Richardson* and *Stanley Mashburn* are giving a literal translation to the first word in the firm name — *Progressive Plating Works*. They are busy running up an addition to their plant at 1247 East Hill Street, which is itself a post-War II development. Richardson reports that a 50 x 80 foot, one-story addition is under erection to house stamping and washing operations incidental to their lighting fixture manufacturing operations and metal finishing facilities. The plating department, already equipped with about a dozen tanks of miscellaneous solutions, is being rounded out with zinc and cadmium set-ups. Upon completion of the addition, the plant, including building and equipment, will represent an investment of $75,000, Richardson estimated.

Harry Bailey, of the *Royal Plating Co.*, Los Angeles, suffered a heart attack early in February and on February 14, the night of the AES Branch meeting, was reported to be still confined to his home. Harry is one of the genuine old-timers of plating in the Los Angeles area. He was already active in the industry in Los Angeles in 1895, and now, 56 years later, still handles his trick at the Royal Plating Co., health permitting. He has been a member of Los Angeles AES Branch for some 20 years, seldom appears at the monthly meetings, but can usually be found in the audience in at least one of the day sessions of the branch's annual educational sessions.

Members attending the February 14 meeting of the branch voted to send some flowers to Harry, with a note bearing the branch's wishes for his speedy recovery.

Western manufacturers and distributors were able to obtain much valuable information at a one-day Institute on Military Procurement held recently at the University of California at Los Angeles. The Institute was sponsored by various departments of the university (Schools of Engineering, Business Administration and Extension Division), in collaboration with various federal agencies, such as Los Angeles Naval Purchasing Office, Los Angeles Air Force Procurement Field Office, Oakland Army Base, Bureau of Aeronautics, Los Angeles office of the Department of Commerce, and Los Angeles Chamber of Commerce.

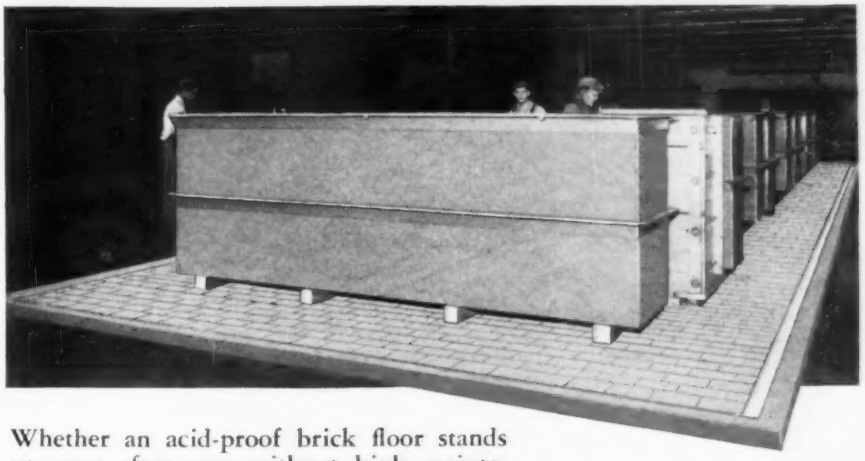
Morning and afternoon panel discussions were held. Matters pertaining to bid procedure for government contracts and listed sources of information engaged the attention of the morning panel. The afternoon sessions dealt with requirements of sub-contractors in the procurement program, and financial and facility requirements.

Pacific Abrasive Supply Co. has moved from 900 East 9th St., Los Angeles, to new and modern quarters at 2670 Leonis Blvd., same city.

Vapor Engineering Corp., manufacturers of industrial ovens, washing units and degreasers, has moved from 341 Sothu Central Avenue, Los Angeles, to new quarters at 5615 Leeds Street, South Gate, Calif.

FOR LESS MAINTENANCE OVERHEAD

put Durisite and Brick UNDERFOOT



Whether an acid-proof brick floor stands up year after year without high maintenance costs depends mostly on the joints between the bricks. The thinner the joint the better the chance for long, trouble-free life. But with ordinary bonding mortars you can't get a joint much thinner than ¼".

Durisite *acid-and-alkali-proof* cement, however, bonds brick double-tight with *extra thin* joints . . . $\frac{3}{32}$" or less. Not only does Durisite make a thin, strong joint, but it makes a dense, non-absorbent joint.

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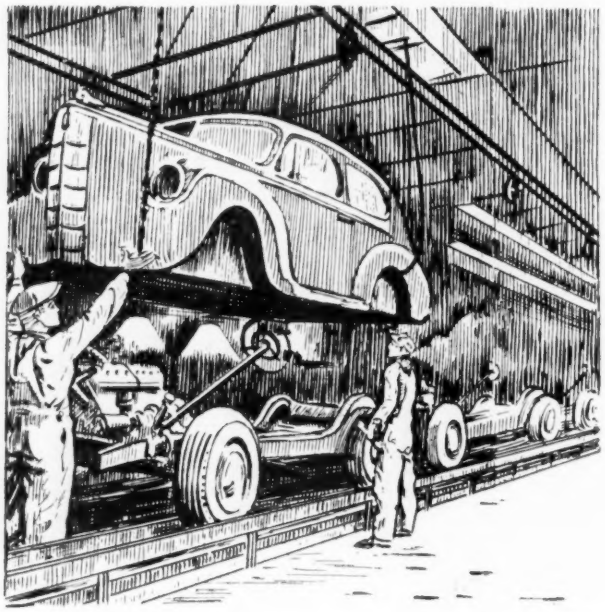

MOTOR CITY PLATING NEWS

by

Edward Finne

Feeling that the Federal government is bypassing the State of Michigan and the smaller fabricators in the issuance of war contracts, *Governor Williams* has lined up 60 representatives of industry, agriculture and labor to form a Defense Production Council.

There seems to be little doubt that the defense program is virtually non-existant in Detroit. Although hundreds of millions of dollars in contracts have been awarded to Michigans' giant corporations, little effect has been felt in the State because the work will be done in branch plants in other states.

It is claimed that industries in Cleveland and Chicago are being favored with war contracts over those in Detroit and other parts of Michigan because of the declared intention of the Administration to keep the automotive and other plants in civilian production. The restrictions on essential materials is greatly hampering produc-

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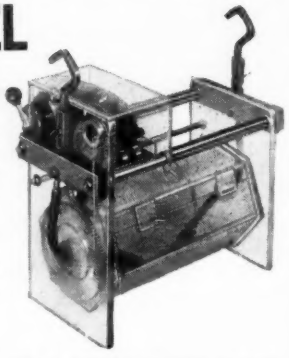

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tion in that line.

Skilled labor is being drawn from the Detroit labor market by the thousands, thus reversing the trend in World War II.

All of which leaves Detroit in a worse muddle than before until some equitable program is eventually worked out.

****

The restriction of nickel to bumpers and bumper guards has platers in the automotive field joining the march to substitute finishes for exterior and interior hardware. Great interest has been shown in clear conversion coatings on zinc as an alternate finish for nickel and chromium on interior hardware and other parts affected by the nickel order. According to one firm, the interest has necessitated their working nights to provide sample parts plated with their product.

Zinc conversion coatings require a base coat of zinc, and the unavailability of this metal has the auto manufacturers, who are contemplating converting to this finish, advancing the argument to the government that a change from nickel to zinc plating in their plants will put them in good shape for conversion to war work.

****

L. P. Jackson was elected president of the *Midwest Abrasive Co.* to succeed his brother, James T. Jackson, who died in an automobile accident on Dec. 22, 1950.

The new president has been with the company since 1936 and has been vice-president of engineering since 1942.

At the special board meeting, *A. C. Reppenhagen*, formerly secretary, was elected treasurer and a director of the company. *R. J. Foresman* was also appointed assistant general sales manager, in addition to his recent election as assistant secretary.

****

Fabco, Inc., of Trenton, Mich., manufacturers of fender guards, announces the appointment of *R. E. Woolens* as general manager and the promotion of *Joseph Joaquin* to general superintendent. Woolens was formerly plant manager for Parker Wolverine of Detroit.

****

The February meeting of the Detroit branch of the AES was held on Friday the 2nd at the Statler Hotel.

T. G. Coyle, vice-president of United Chromium, talked on the Self Regula-

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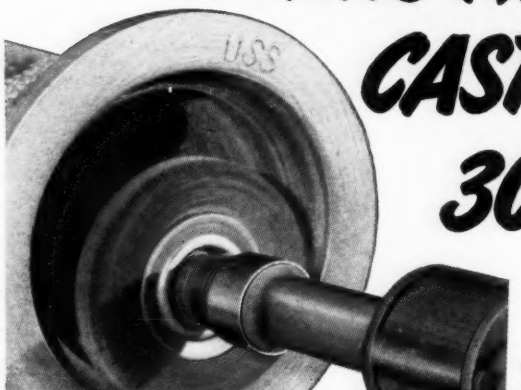

**An actual case history from the U. S. Pipe and Foundry Company, Birmingham, Ala.*

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ting Chromium Plating Solution, the newest development of the concern, and its industrial applications with special emphasis on the use of this bath for defense work.

****

Headlines in Chemistry, a series of broadcasts produced under the auspices of the American Chemical Society, went on the air on Saturday, January 20, over Station WJLB. The weekly quarter hour program is heard each Saturday morning at 10:45 and is designed to familiarize the public with current developments in the chemical world. It will serve to translate into easily understandable language the week's advances in a wide variety of technical fields — advances which each day affect the lives and living habits of every Detroiter.

Along with news of the industry, the program will feature helpful chemical solutions to every day problems confronting the housewife, the car owner and the man on the street in general.

Associations and Societies

AMERICAN ELECTROPLATERS' SOCIETY

1951 Convention Site Changed from Los Angeles to Buffalo

At a recent meeting of the Executive Committee of the AES, the decision was made to change the convention site and dates for the 38th Annual Convention. Originally scheduled for Los Angeles during June, the Convention will instead be held at Buffalo, N. Y., during the week of July 30, July 31, August 1-2. Convention headquarters will be at the Statler Hotel, Buffalo.

The following committee will be in charge of all arrangements.

General Chairman — *Bert Kirchoff.*
Co-Chairmen — *Wm. Fotheringham.*
Dr. C. J. Wernlund.
Educational — *Dr. C. J. Wernlund.*
Finance — *Stanley Bush.*
Registration — *William Hart.*
Hotel Reservations —
B. P. Fortin, Jr.
Program —
Hi Fudeman, Joan T. Wiarda.
Reception — *Wm. Fotheringham.*

Public — *Joan T. Wiarda.*
Banqu — *James Moneypenny.*
House — *Anthony Nigro.*
Outing — *Joseph Ruff.*
Transportation — *Leon Nowak.*
Ladies — *Mrs. Anthony Nigro.*

Los Angeles Branch

The Los Angeles Branch met at Rodger Young Auditorium, Los Angeles, on the night of February 14, with 65 members and guests in attendance.

The program was divided into a social period from 6:30 to 7 o'clock, dinner from 7 to 7:30, a business session from 7:30 to 8, followed by an educational session.

Richard Wooley, president, presided over the business session, at which the following visitors were introduced: *Van Oslen*, of California Metal Process Co.; *Al Balk*, Harshaw Chemical Co.; and *Lester Borlet*, Pacific Coast representative, United Chromium, Inc.

Seven new members were formally initiated. These were: *Theodore Kertu*, Tool & Jig Plating Co.; *David Althouse*, *Donald Fish* and *Irving Halperin*, of L. H. Butcher Co.; and *Harry Lieb*, *Robert Hungerford* and *Daniel Gilfer*.

President Wooley related the circumstances that influenced the decision to transfer the 1951 AES convention out of Los Angeles. He explained that holding a convention in Los Angeles is attended by circumstances differing from those usually prevailing when a conclave is held in a more centrally located area of the middlewest or Atlantic Coast. Conditions must be normal to make it possible for men to travel several thousand miles to a convention, he pointed out. Shortly after the first of the year, Wooley continued, doubt about the practicability of staging a successful convention on the west coast developed among Los Angeles branch leaders. The concensus of opinions was that by June (convention time) many people who had planned to come to the convention in Los Angeles would not be able to do so because they would not be able to absent themselves from their business affairs for the length of time it would require to visit the Pacific Coast.

Wooley reported that when these sentiments were conveyed to the Supreme Society officials, a meeting was called in Chicago on January 26 at which he (Wooley) explained the pos-

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ition of Los Angeles Branch. Wooley added that *William Neal*, who had shortly before returned from Washington, where the growing gravity of the national crisis impressed itself upon him, was likewise frankly skeptical of the chances of conducting a successful convention on the Pacific Coast this year.

The group attending the Chicago meeting then decided — with the complete and full accord of Los Angeles officers and executive board members. Wooley emphasized — to postpone the Los Angeles convention insofar as 1951 is concerned. He reported that he was assured that when conditions return to normalcy, the holding of an AES convention in Los Angeles will meet with the enthusiastic approval of the Supreme Society.

Upon completion of Wooley's comprehensive report, the matter of electing delegates to attend the convention at its new site — Buffalo, N. Y. July 30 to August 2 — was taken up. Wooley and *Don Bedwell* were named delegates and the board of managers was empowered to appoint alternates as needed.

A report by *Jack Beale*, chairman of the Research Committee, which started out as a mere pep talk for more sustaining members, developed, into one of the finest inspirational talks on the value of the AES research program that has been given before the branch in a long time. Beale also reported that the *A. J. Lynch Co.*, for whom he serves as supervisor of the plating department, has subscribed to a $100 sustaining membership, bringing to nine the number now held by the branch.

The speaker of the evening was *Stuart Krentel*, deposition technician of the *Spence Electro Plating Co.*, Los Angeles, who drew upon his wide experience as a field engineer both in the east and the west to give the members a top-notch talk on "Anodizing of Aluminum." Adding to the merit as well as the interest of Krentel's talk was the liberal manner in which he outlined formulae and drew plans and diagrams of equipment setups and plant layouts on the blackboard.

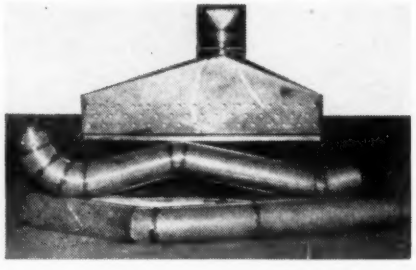
Comparing the chromic and sulfuric acid processes, Krentel pointed out that there are a few points of similarity, but that the points of dispartiy are far greater. The chromic acid method, he declared, is a "batch" process, in which the tank must be loaded, the necessary current adjustments made, and the full cycle run. He defined sulphuric acid anodizing as a continuous process, the same as plating.

Annual Educational Session

The Branch will hold its 1951 annual educational session at Rodger Young Auditorium, Los Angeles, on Saturday, April 21.

While plans for staging the 1951 AES national convention in Los Angeles were still in progress, the branch, for the first time since its founding, had decided to forego a local educational session. However, when it became expedient, in view of the national crisis, to transfer the convention to a more convenient middle-western location, The Branch reacted promptly to set the wheels in motion for a belated annual educational session.

Committee machinery was already in existence and the officers and directors simply switched its national convention committee to work on arranging a speakers program, dinner, and ball for the local affair. *Don Bedwell*, general chairman of the Los



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Angeles national convention committee, and his various sub-committee chairmen agreed to carry the ball again in preparing for the branch educational session.

The annual dinner and dance is scheduled for the evening, beginning at 8 p.m. A dance contest conducted at the 1950 ball under the direction of *John Millhorn* was so well received that Millhorn has been delegated to stage a return performance.

Pittsburgh Branch Annual Banquet and Dance

The Pittsburgh Branch of the AES will hold its annual Ladies' Night Banquet and Dance in the Hotel Sheraton Ballroom on April 14. The Committee, under the chairmanship of *Ken Carpenter*, promises good food, good entertainment, and good music. The Pittsburgh Branch will welcome the presence of members of other Branches at this gala affair.

Milwaukee Branch Annual Educational Session

The Milwaukee Branch, AES announces its annual meeting and banquet to be held at the Schroeder Hotel on Saturday, April 28th, 1951. In a Symposium on "*Finishing for Defense*," the following three gentlemen will speak, starting at 2:00 p.m.:

1—*Dr. William Blum*, of the National Bureau of Standards, Washington, D. C., will speak on "*Specifications for Defense Plating and the General Situation as Regards Civilian Plating.*"

2—*Mr. Carol Hutchinson*, of the Nubian Div. of the Glidden Co., Chicago, Ill., will speak on "*Preparation of Metals for Organic Finishing — Specifications for Organic Finishing, and Post Treatment of Metal Surfaces for Defense Applications.*"

3—*Mr. Myron Diggin*, of The H-VW-M Co., will talk on "*Plating to Meet Today's Conditions.*"

Mr. Vincent Matticotta, the Educational Chairman, has put forth a great deal of effort in arranging this timely program and the well known speakers and their subjects make elaboration unnecessary. *Mr. Ted Hartsorn*, General Chairman of the Annual Meeting, has announced that all arrangements to make this a great convention are completed. *Glenn Schwemmer*, Banquet and Entertainment Chairman, promises a full evening with the banquet starting at 7:00 p.m., during which you may enjoy dinner, music by a leading orchestra in Milwaukee, followed by a floor show and dancing until 12:30 a.m.

Mr. Robert Steurnagel, Chairman in charge of Ticket Sales, requests that orders for tickets be mailed to him, care of *S. K. Williams, 2372 N. 32nd St., Mil., Wis.*

Cincinnati Branch

One of the largest crowds to attend a Cincinnati Branch meeting was on hand January 24, 1951 when forty-six members and guests greeted *Dr. M. M. Beckwith*, of *The Harshaw Chemical Co.*. After the usual delicious dinner which members now anticipate at Cincinnati's Engineering Society, President *Ezra A. Blount* presented Dr. Beckwith, who took as his subject "Chasing Impurities." Dr. Beckwith opened his talk by defining impurities as "something out of place" although he stated that under the right conditions and in the right solution that "something" was not out of place. He then mentioned that an AES Research Project is being devoted to the study

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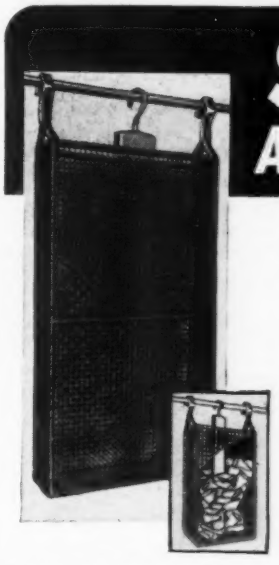

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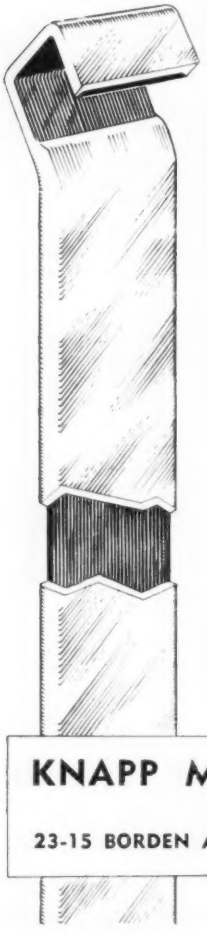
of impurities, while work is almost completed on Determinations of Zinc in Nickel Solutions, with the expectation that similar studies on Silicates and Phosphates will be finished in the near future so as to eventually simplify the removal of such impurities. The speaker then discussed the effects of germanium, comparing the quantities of impurities found in test runs of Missouri and New Jersey zinc ores over a period of 18 months in pilot plant runs. Emphasizing the effect of time and temperature on the growth of precipitations, and the different reactions of activated carbons in removing impurities, Dr. Beckwith concluded his talk, which was followed by a spirited question and answer period.

After a short business meeting at which the application of *Elmer Sams* was presented and accepted, the members adjourned for refreshments which were furnished by *The Globe Chemical Co.*, Cincinnati.

1952 Annual Convention Plans Being Mapped Out

The 1952 Convention Committee and the Executive Committee of the *American Electroplaters' Society* met at the Stevens Hotel in Chicago on January 27th, 1951. The meeting was held in conjunction with the Annual Educational Meeting and Banquet of the Chicago Branch of the *American Electroplaters' Society*. Those present were: (reading clockwise)—

Art Bartman, Chicago Branch; *Rudy Hazucha*, Chicago Branch; *Klem Petrosius*, Chicago; *Dr. J. H. [illegible]naweck*, President, Chicago Bran[illegible]; *Dick Wooley*, Los Angeles Branch; *Dr. George Swift*, 3rd Vice-President, Supreme Society, Boston; *C. F. Nixon*, 1st Vice-President, Supreme Society, Detroit; *Marion Longfield*, Co-Chairman, 1951 Convention; *Mrs. Marion*



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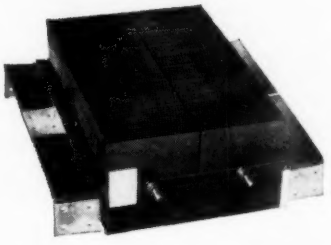

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Longfi[illegible], Ladies Chairman, 1952 Convention; *Paul Glab*, Secretary, Chicago Branch; *Franklyn MacStoker*, 2nd Vice-President Supreme Society, N. Y.; *Clyde Kelly*, General Chairman, 1952 Convention, Chicago Branch; *Bill Neill*, President, Supreme Society, Columbus, O.; *Harold Smallman*, Western Manager, Hanson - Van Winkle - Munning Co.; *Joe Andrus*, Librarian, Chicago Branch; *A. K. Graham*, Executive Secretary; *Henry Bornitzke*, Milwaukee Branch; *H. A. Gilbertson*, Former President Supreme Society, Chicago; *Leonard Weeg*, Rockford Branch, *Wm. Geissman*, Rockford Branch; *Dr. H. J. Weisner*, St. Joe Valley Branch; *Harold Faint*, Chicago Branch; *Ray Ledford*, Publicity Chairman.

Baltimore-Washington Branch

Supreme Society President *W. J. Neill* was the guest of honor and speaker at a dinner meeting on January 9. Mr. Neill spoke first about stream pollution abatement, and emphasized that it should be regarded as an economic necessity rather than merely a desirable objective. Calling forth information about his home territory, he stated that damage suits in Columbus, O. have amounted to 4 million dollars, and 6 millions were required for an adequate sewage treatment plant. He ascribed stream pollution to three sources, namely sanitary, industrial and soil erosion wastes. He described the organization of the Ohio Valley Water Commission, operating as an eight-state compact, one division of which is the Industry Action Committee. A sub-group of the latter is composed of representatives of the Metal Finishing Industry, with several AES members assuming prominent roles. For platers Mr. Neill voiced the opinion that many pollution problems can be solved or alleviated by better housekeeping, with specific waste treatment required for the remainder.

Mr. Neill continued with a discussion of plating on non-conductors. He began by conjuring up memories of his early exposure to plating, one of his first jobs being to plate 10,000 peanuts! He described in detail the modern techniques employed for plating baby shoes, tobacco leaves, champagne corks, etc.

Continuing with the custom of recent years, *Ken Huston* presented Mr. Neill with a beautifully plated and engraved Pot, thus qualifying him for the Order of the Pot. It was commented that whereas many people have become acquainted with a fur-lined pot, few indeed there be who posses a gold-lined pot such as this one. The gathering for this ceremony was an illustrious one, considering the presence of Past Supreme Presidents *Fred Fulforth*, *Tom Slattery* and *Ken Huston*; *F. F. Pierdon*, a charter member of the Society; and *W. W. Chase*, a charter member and organizer of the Baltimore-Washington Branch. Appropriate to the occasion, a number of photographs were taken to record it for posterity.

A nominating committee consisting of *Abner Brenner*, Chairman, *Carl Thiede*, and *Ken Huston* was appointed and charged with bringing in a slate of officers for election at the next meeting on February 13, when the Branch will tour the Electrodeposition Section of the National Bureau of Standards. The March Brush Development Co.

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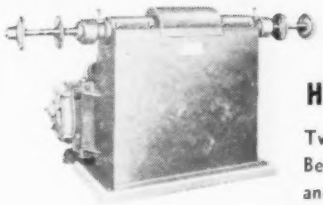

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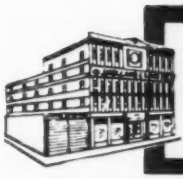

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speaking on "Faxfilm," a means of examining metal surfaces. "What Happens in a Plating Barrel" will be the topic of *Mr. H. J. Struckhoff* of Lasalco, Inc. at a meeting tentatively scheduled for April 10.

New England Regional Meeting

The 12th Annual New England Regional Meeting of The AES will be held on Saturday, April 28, 1951, at the Hotel Taft, New Haven, Conn.

The technical session will start at 2:00 p.m., with the Banquet following at 7:00 p.m. A floor show and dancing will be featured in the evening's affair.

Tickets may be obtained from *E. V. Collins*, Box 127 Bantam, Conn.

St. Louis Branch Annual Banquet

The St. Louis Branch of the American Electroplaters Society is holding a Spring banquet at 7 p.m. on April 21, 1951 at the Starlight Roof of the Hotel Chase, St. Louis, Missouri. There will be no educational session in the afternoon. Tickets at $5.00 per person can be obtained from *Arthur P. Wrisberg*, 2818 LaSalle Street, St. Louis 4, Mo.

AMERICAN SOCIETY FOR METALS

33rd Anunal Metal Show Scheduled for Detroit

The 1951 Metal Show will be held on October 15-19, 1951, at *Michigan State Fair Grounds*, Detroit, Mich. Technical sessions will be held in the principle downtown Hotels in Detroit.

Sponsors for the affair are The American Society for Metals; American Welding Society; Metals Branch, American Institute of Mining and Metallurgical Engineers; Society for Non-Destructive Testing.

ELECTROCHEMICAL SOCIETY

Annual Spring Meeting

The Spring Meeting of the Electrochemical Society will be held at the Wardman Park Hotel, Washington, D. C. during the week of Apri 8-12.

Over 120 technical papers are scheduled for presentation at this meeting, which will make it the largest technical program ever presented by the Society.

Sunday, April 8 has been reserved for Board and Committee meetings, and the technical sessions will be started on Monday morning and run through to Thursday afternoon. Several visits to the National Bureau of Standards have also been arranged for. *Dr. Condon*, Director of the Bureau of Standards, is expected to address the Annual Luncheon of the Society on Monday, April 9. Various Division luncheons, buffet supper, the Richards Memorial Lecture, and an extensive program for the ladies will round out the week's activities.

The principal Divisions of the Society which are holding sessions are the Electrical Insulation, Electronics, Electrothermics, and Theoretical Electrochemistry Divisions.

A reception to honor *Dr. Charles L. Faust*, President of the Society, will be held prior to the Banquet on Tuesday evening. Dr. Faust will deliver the Presidential Address at this Dinner.

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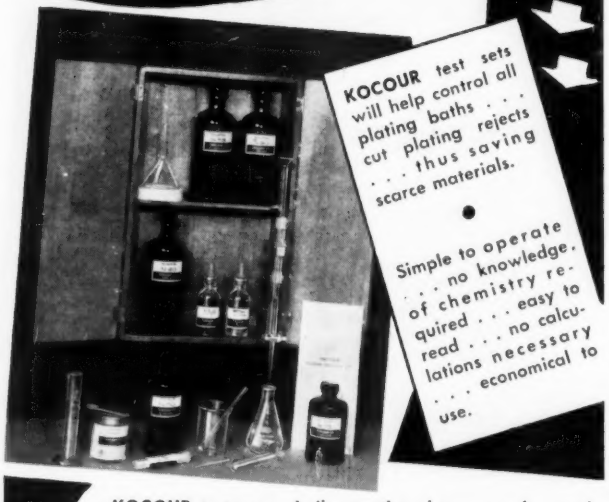
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(Continued from page 70)

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Tin

(NPA M-8)
Amended Jan. 27, 1951.

The following list of items *may* be plated with tin for protective or functional purposes only. All other uses of tin plating are prohibited. No decorative tin plating is permitted after March 1, 1951.

(1) Dairy equipment, including fluid milk shipping containers, ice cream cans, strainers, pails, and other dairy equipment.

(2) Equipment for preparing and handling food, including kitchen utensils, galley and mess equipment. Only actual food contact parts.

(3) Cutlery and flatware.

(4) Copper or brass pipe and fittings:
- (i) Tubing or fittings to dispense beverages or distilled water.
- (ii) Tubing or fittings used as refrigeration tubing or in contact with beverages or drinking water in beverage or drinking water equipment.

(5) Snap fasteners and hooks and eyes. Tin or tin chemicals may be used for barrel plating or chemical plating.

(6) Copper-base alloy wire and strip:
- (i) Wire—0.032" nominal diameter or finer.
- (ii) Wire—larger than 0.032" nominal diameter. Coat with alloy containing not more than 12% tin by weight.
- (iii) Strip—0.0250" thick or thinner where solderable coating is required for electrical connection. Coating limited to .0004" in thickness.
- (iv) Strip—where solderable coating is required for radiators and heat exchangers. Coat with an alloy containing not more than 15% tin by weight.

(7) Steel wire, for following purposes:
- (i) Liquor finishing process of fine steel bright wire.
- (ii) Armature binding wire and wire for all electrical equipment and aircraft parts including aircraft wire and cable.
- (iii) Wire having ultimate tensile strength of 100,000 lbs. per sq. in. for manufacture of stranded cable (not including picture wire, fishing leaders and like items) but including musical instrument strings.
- (iv) Spring steel wire for use as springs where prime function of the wire is a spring and alternative coatings cannot be used (this does not include wire for spiral binding and like applications).
- (v) Wire for use in manufacture of equipment for the production of textiles.
- (vi) Wire for manufacture of pin tickets and tag wire in direct contact with garments and other textiles and including dry cleaning and laundry tag use, for pin type card holders and brake strand.
- (vii) Beekeepers' wire for comb construction.
- (viii) Wire for packaging or marking food where wire comes into actual contact with edible portions of the food.
- (ix) Bookbinders' wire or preformed staple wire to be used in foot or power operated stitching machines using wire in coils or spools or preformed staples for the following:
  - (a) Stitching of magazines, books, booklets and pamphlets, other than those used solely for advertising purposes.
  - (b) Preformed containers for dairy products and other foods and for pull-up tabs for bottles and tubs only where the wire comes into direct contact with the food.
- (x) Stitching wire and wire for staples to be used in hand, foot or power operated stitching machines using wire in coils or spools or preformed staples for the following:
  - (a) Attaching tabs and tickets to garments, other textiles, leather and imitation leather, and sheet plastics, and for attaching these

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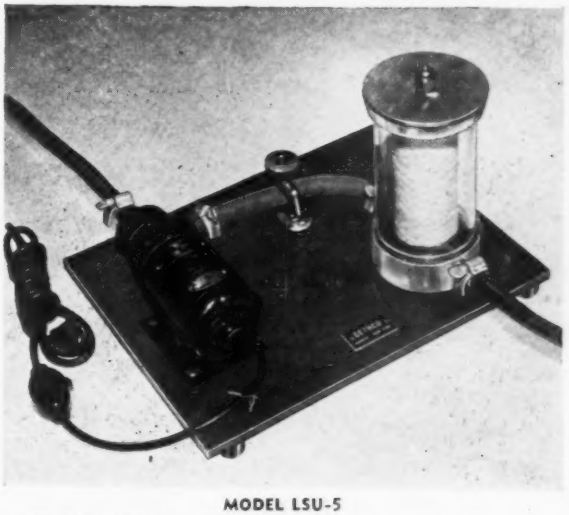

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items to other items or materials:

(b) Stitching and stapling in industrial manufacturing operations where tinned stitching wire or staples are required for penetration and alternative coatings cannot be used (this does not include wire for office staples, staples for tea bags, book matches or box and carton construction).

(8) Tin plate and terne plate. Pig or secondary tin may be used to coat tin plate and terne metal containing not more than 15% tin to coat short ternes and roofing ternes and terne metal containing not more than 10% tin may be used to coat all other long ternes in accordance with the specification limits stated in NPA Order M-24.

(9) Sheet (other than tin plate, terne plate, or tin mill black plate), tubing; wire, foundry chaplets, etc. Lead-base alloys containing not more than 7% of tin, may be used to coat, if the alloys are derived from secondary tin only.

(10) Steel bearing shells. Pig or secondary tin may be used to electro-tin to a thickness not exceeding .00006".

(11) Electrotype shells. Pig or secondary tin may be used to electro-plate, electrotype shells only where such installations were operating on or before the effective date of this order, Jan. 27, 1951.

This order permits lead-base alloys containing not over 4% of Tin to be used as tank linings and plating anodes *if the alloys are derived from secondary tin only.*

ALUMINUM RESTRICTIONS

The recent Amendment of Feb. 1 to NPA Order M-7 lists in detail the prohibited uses for aluminum. No new production of these items in aluminum may be started after April 1, but work in process on or before March 1st and which will be completed by May 31, may be sold after these dates. The limit of 65% of the previous base period's consumption for non-restricted items is still in effect for March.

For maintenance and operating supplies, which covers wire used in anodizing, monthly use is confined to an amount not over the average monthly amount used in the equivalent base period (June-December 1950). Restrictions on operating supplies and maintenance supplies do not apply to users of less than 1,000 lbs. of aluminum per year.

The amendment does not restrict the use of aluminum in bus bars, provided that the suppliers have them on hand and had accepted orders for them prior to Nov. 13, 1950 for delivery before April 1, 1951.

The complete list of items for which aluminum may *not* be used is as follows:

Airfoil (tubing) for windmills.
Aluminum wool.
Andirons, screens, and fireplace fixtures.
Animal cages.
Animal training equipment.
Animal traps.
Applicators for moistening envelopes.
Arbors and trellises.
Architectural and other building ornamentation.
Ash trays.
Automobile hardware and trim (except functional parts).
Awnings.
Badges.
Balloon molds.
Bar rails.
Barber chairs.
Batons.
Bathtubs.
Beauty parlor equipment.
Beer equipment: all items.
Bells.
Beverage mixing and serving equipment, such as bottle coolers, cocktail shakers, ice buckets and pails, ice chippers and shavers.
Bicycles.
Bird and pet cages, houses, aquariums, accessories and equipment.
Blackboard frames and chalk troughs.
Boards: shampoo, tanning.
Book covers.
Book stacks.
Boxes, including match, cigarette, typewriter ribbon.
Brackets: light, shelf and wall.

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Cameras, amateur box type still picture, fixed focus (except reflex).
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Cans, including ignition coil and motion picture humidor.
Caps: chimney and vent flue.
Card tables.
Cards, greeting.
Carriages: baby, luggage, strollers, scooters (except functional parts).
Cases:
- Cigar.
- Film.
- Radio, home type.
- Soft drink.
- Spectacle.
- Vanity.

Caskets, and accessory devices.
Caster cups, wheel casters and glides.
Chicken crates.
Chutes: coal, package and waste.
Cigarette lighters.
Cleaning accessories, such as carpet sweepers, dust pans and scrubbing sets.
Clothespins.
Coasters.
Combs.
Containers, foil lined, shoe polish.
Coops, brooder, chicken, quail, etc.
Copings.
Cornices.
Crayon molds.
Cups.
Curtain, drapery, and carpet hardware.
Cutlery handles.
Cuspidors.
Desk pads.
Dispensers, fixed or portable, for soap, lotion, paper, straws, etc.
Dolls.
Domestic laundry accessories, such as tubs and boilers, washboards, drain board and tub covers, clothes hampers, ironing boards and tables, garment stretchers and dryers, clothes drying frames, and clothes line hardware.
Door chimes.
Doors, including, but not limited to:
- Coal.
- Door frames.
- Dumbwaiter.
- Incinerator.
- Screen.
- Storm.

Draperies.
Dresser sets.
Emblems, medals (except religious), crestings and plates.
Fences, wire.
Flag poles, stanchions and sockets.
Floor scrubbers.
Flower boxes, stands and pot holders.
Forms, concrete vault casting, wax.
Fountains.
Frames:
- Electric sign.
- Level.
- Picture.

Frames, Window Screen.
Frozen fruit sticks.
Furniture.
Furniture, hardware (except functional parts).
Games.
Garden tools and equipment.
Garment hooks, brackets, racks, rods, trees and hangers.
Giftware.
Gutters, leaders and downspouts.
Hair curlers.
Hand-tool handles.
Hedge clipping machine.
Highway markers, signals and signs.
Holders:
- Brush.
- Pen.
- Soda fountain cup.

Horse shoes.
Hollow ware (tea sets, etc.).
Ice cream freezers for home use.
Jewelry, all types (except religious goods).
Kick plates.
Kitchen utensils and tools, and food processing equipment (except cooking and baking utensils).
Ladders and step stools (except industrial and fire).
Lawn and garden hose accessories, such as sprinklers, nozzles, couplings, clamps, menders, and reels.
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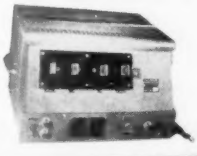
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  Tree.
Medicine cabinets.
Memorials and tablets.
Mesh bags.
Metal lath.
Metal letters and numbers.
Mops.
Mouldings and trim.
Mud scrapers.
Nursing bottles.
Oil cloth, foil-covered.
Ornaments, Christmas tree.
Packaging:
  Containers for:
    Bath salt.
    Cosmetic, except collapsible tubes.
    Gift.
    Powder.
    Tube, for cigar.
  Jars, beauty cream.
  Shakers, talcum powder.
  Foil for:
    Capsules.
    Cartons, liquor.
    Florist.
    Household.
    Labels.
    Over wraps (except food).
    Wraps: gift, cosmetic, liquor.
    Wine bottle.
Paper clips.
Plates: name, scuff (except instruction plates on equipment).
Playground equipment.
Pleasure boat fastenings, fittings and hardware.
Portable bleachers.
Push plates.
Roofing, residential type (including shingles).
Rulers.
Saddlery, and harness hardware.
Screening (except insect wire screening).
Shoe heels.
Shovels, scoops, scrapers and pushers, (except as required for handling chemical products and grain).
Siding, (except industrial).
Signs, including advertising.
Smokers' accessories.
Soap dishes.
Souvenirs and novelties, advertising specialties.
Spandrels.
Spools: wire, adhesive tape.
Sporting goods, all kinds (except commercial fishery goods).
Spray guns (except paint spraying equipment and agricultural sprays).
Spurs, climbing.
Statuary (except religious and artists originals).
Stencils.
Store fronts, (except glass holding members).
Stove pipe.
Tent poles, frames and pegs.
Thermostatic containers, (except shoulders and cups on vacuum bottles of one quart and under size).
Toilet seats and covers.
Tokens (except where necessary for electrical operation).
Tombstones.
Tooth brush and tumbler holders.
Towel bars.
Toys.
Tricycles and other children's vehicles.
Umbrellas and parasols.
Venetian blinds, fittings and accessories.
Vending machines (except functional parts).
Waste baskets.
Wheel barrows (except as required for handling chemicals).
Whistles.
Windows, storm (except sash slides).

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